

# FIRST CHARACTERIZATION OF DEEP SEA HABITATS IN CORDELL BANK NATIONAL MARINE SANCTUARY: *E/V Nautilus 2017*



*E/V Nautilus cruise: August 6-12, 2017*

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Report completed December 2019  
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## Introduction

Cordell Bank National Marine Sanctuary and Ocean Exploration Trust explored deep areas of the sanctuary in August 2017. These areas had never been surveyed and information was needed about habitats and biological communities to effectively manage the area. Using maps created from the bathymetric and backscatter data collected during NA080 in May 2017, remotely operated vehicle dive targets were identified in areas with hard substrate and high slope, which are indicators of potentially suitable substrate for corals and sponges. Sites were selected across a north-south gradient, as well as a depth gradient thought to be suitable for corals and sponges.

The primary objectives of NA085 in Cordell Bank National Marine Sanctuary (CBNMS) were:

1. Conduct visual surveys using a remotely operated vehicle (ROV) of canyons and slope, focusing on potential hard substrate areas to survey for deep sea coral, sponges, and fish.
2. Collect biological samples of deep-sea corals and sponges and associated species for identification, age, and growth rates; and water samples for eDNA analysis.
3. Collect environmental and physical data to evaluate climate conditions and impacts, such as carbonate chemistry of water, condition of corals, and sediment composition.

From August 6-12, 2017 ROV surveys using *Hercules* ROV off the E/V *Nautilus* (owned and operated by the Ocean Exploration Trust) were conducted in Bodega Canyon (three dives: H1625, H1626, and H1630), in an unnamed box canyon south of Bodega Canyon (one dive: H1627) and on the deep slope to the west of Cordell Bank (two dives: H1628/H1629), ranging in depths from 744-2737 meters (table 1, figure 1). A total of 76 hours of visual surveys were completed, over 230 samples were collected including organisms, sediment, and water. Biological specimens were identified by California Academy of Science (CAS) researchers and other collaborators. University of California, Davis scientists will analyze water carbonate chemistry, sediment samples for benthic organisms and geochemistry, and age and chemical composition of coral skeletons. National Marine Fisheries Service scientists will analyze water samples for eDNA. Species abundances and distribution were quantified from the ROV video imagery and are reported by dive number in this report.

The cruise significantly expanded the information about deep habitat in CBNMS, and opens up new topics for future research and outreach. All the ROV dives were broadcast on [Nautiluslive.org](http://Nautiluslive.org) allowing people around the world to see the research and CBNMS in real time. Through live streaming at least 16,000 viewers were reached from around the world. In addition, the deep sea mission to CBNMS was directly shared with nearly 900 people during 30 live interactions, including 170 people on August 12 for “Get Into Your Sanctuary Day,” a day the Office of National Marine Sanctuaries coordinates to connect communities to their local sanctuary.

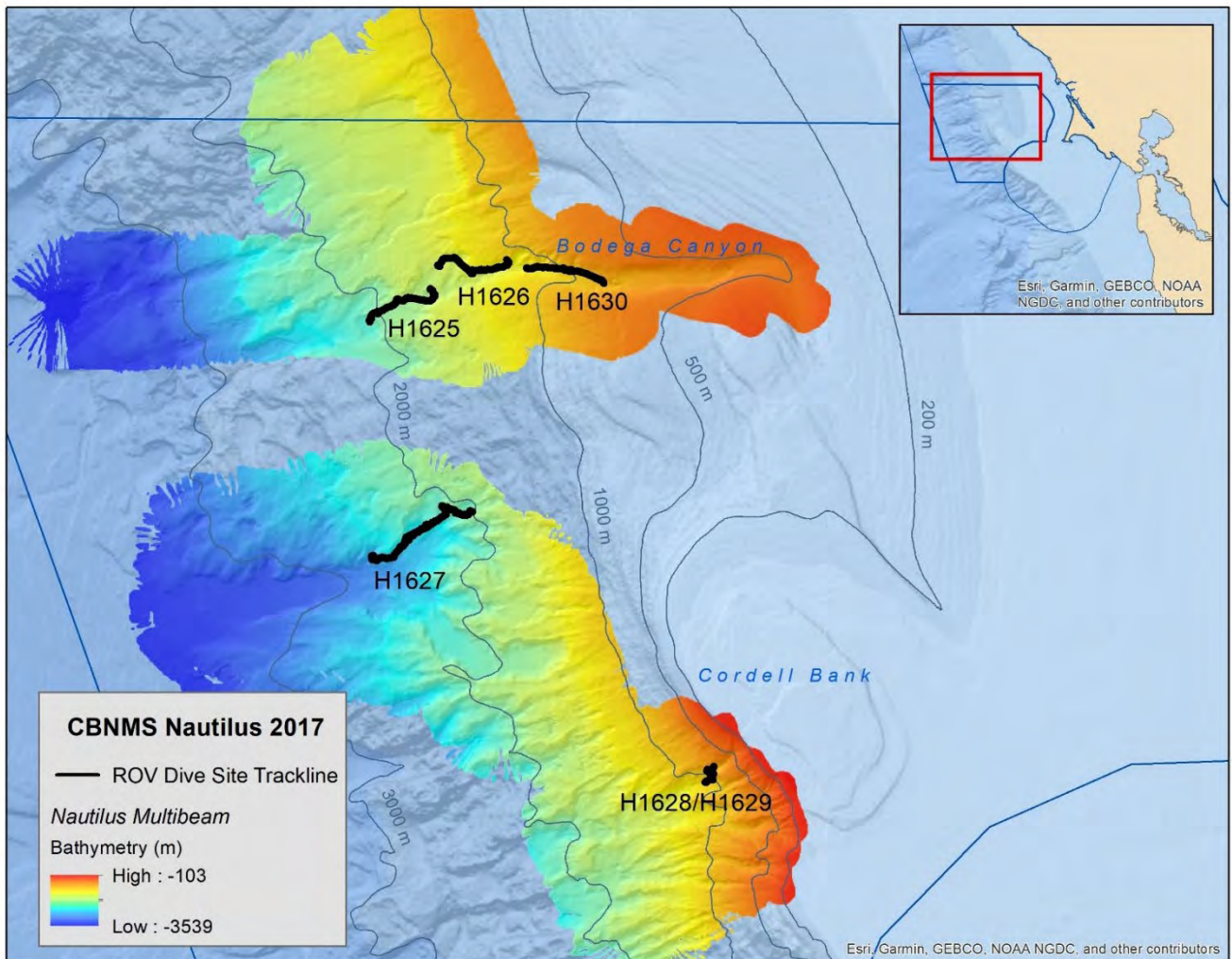
## Cruise Participants and Partners

- Onboard: Danielle Lipski, CBNMS (lead scientist and watch lead); Dan Howard, CBNMS (watch lead); Jan Roletto, GFNMS (watch lead); Jennifer Stock, CBNMS (outreach); Gary Williams, CAS (scientist); Carina Fish, UC Davis (scientist)
- Scientists ashore: Kaitlin Graiff, CBNMS; Tom Laidig, NFMS-SWFSC; Guy Cochrane, USGS; Tessa Hill, UC Davis; Meredith Everett, NFMS-NWFSC

Table 1. Dive details including dive duration, ROV depths, total corals and sponges observed, sample numbers.

Dive Number	Site Name	Date (UTC)	Total Dive Time (hrs)	Total Bottom Time (hrs)	Bottom Depth Maximum (m)	Bottom Depth Minimum (m)	Total Corals Observed	Total Sponges Observed	Sample ID range
H1625	Bodega Canyon I	8/7/2017	21.25	17.96	2207	1660	2343	896	NA085-001 - NA085-021
H1626	Bodega Canyon II	8/8/2017	17.85	15.29	1599	1205	3270	667	NA085-022 - NA085-040
H1627	Box Canyon	8/9/2017	24.91	20.7	2737	1976	3367	2594	NA085-041 - NA085-057
H1628	SW of Cordell Bank I	8/10/2017	4.29	2.38	1126	1005	282	0	NA085-058 - NA085-060
H1629	SW of Cordell Bank II	8/10/2017	10.25	8.31	988	866	919	619	NA085-061 - NA085-074
H1630	Bodega Canyon III	8/11/2017	14.03	11.65	1291	744	1595	647	NA085-075 - NA085-089

Figure 1. Study site with six ROV dive tracklines in the Cordell Bank National Marine Sanctuary. Dive numbers correspond to table 1.



## Data Analyses and Highlights

All video recorded by the *Hercules* ROV while surveying the seafloor was analyzed. Counts of corals, sponges, and fishes were continuously recorded. Transects for animal density estimates were not created post hoc because the ROV was primarily in exploratory mode and did not follow typical transect requirements of keeping a consistent speed and height off bottom for a set duration or distance. The goal of the video analysis was to collect as much coral, sponge, and fish observation data as possible to add to the sanctuary species inventory, and understand community diversity and distribution across depths and habitats. Coral, sponge, and fish counts are georeferenced using the ROV's navigation data and were also joined to CTD and O2 sensor data.

Corals and sponges were identified from ROV video to the lowest taxonomic level possible using deep sea taxonomic guides from The Monterey Bay Aquarium Research Institute<sup>1</sup> and Monterey Bay National Marine Sanctuary<sup>2</sup>. Specimens collected by the ROV were identified by Gary Williams (CAS) and collaborators. The specimens identified by taxonomic experts were matched to the ROV's in situ images for the purpose of confidently identifying the corals and sponges from imagery. Many taxa are not identified to species level as they are new observations for CBNMS or their taxonomy is unknown. The advancements in sampling capabilities for deep-sea corals and sponges allows taxonomists and scientists to better describe and understand these species now and on future expeditions.

Of the 38 coral taxa observed, 31 taxa were previously unknown to live in the sanctuary and are new observations for CBNMS. Notably, the corkscrew coral, *Radicipes stonei*, is a range extension as it had only previously been found at two localities in the Aleutian Islands, Alaska (Ralf Cordeiro and Gary Williams, pers. comm.). Eleven of the 21 sponge taxa documented are new observations for CBNMS. One of the sponges is a new species to be described; a branched form of *Farrea* sp. nov. The sponge, *Caulophacus schulzei*, was observed and previously known to occur from northern Peru through southern California so it is a range extension from Point Conception, California (Henry Reiswig, pers. comm.). A large mushroom shaped stalked sponge was seen on the deeper dives and could be *Caulophacus* cf. *adakensis*, which would be a range extension from the Aleutian Islands, Alaska (Bob Stone, pers. comm.); a sample will be collected at the next opportunity to confirm identification.

The following tables 2 and 3 include all coral and sponge taxa observed on the six dives conducted during cruise NA085 in CBNMS. Taxa are organized by major groups with accompanying data about total counts, percent of total corals or sponges, individual height ranges, depth ranges, average depth observed, if the taxa were previously undocumented in CBNMS, and if a collection of that species was made. The figures that accompany the coral and sponge taxa tables (figures 2 and 3) display the minimum and maximum depth ranges observed of coral and sponge taxa for all dives, but do not account for abundance. The purpose of these figures is to illustrate the overlap and/or transitions of coral and sponge taxa as depth changes to better understand the distributions of these new coral and sponge observations in CBNMS.

<sup>1</sup> Jacobsen Stout, N., L. Kuhnz, L. Lundsten, B. Schlining, K. Schlining, and S. von Thun (eds.). The Deep-Sea Guide (DSG). Monterey Bay Aquarium Research Institute (MBARI).

<sup>2</sup> Burton, E.J., L.A. Kuhnz, A.P. DeVogelaere, and J.P. Barry. 2017. Sur Ridge Field Guide: Monterey Bay National Marine Sanctuary. Marine Sanctuaries Conservation Series ONMS-17-10. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries, Silver Spring, MD. 122 pp.

Table 2. Coral taxa observed on all NA085 dives reported as total number and percent of total corals with respective height ranges, depth ranges, if a new observation for CBNMS, and number of collections made.

Common Name	Scientific Name	Total Number	Percent of Total	Height Range (cm)	Depth (m) Range	Depth (m) Average	New Species Obs for CBNMS	Num. of collections
<b>CORALS</b>								
Bamboo Coral	<i>Acanella</i> spp.	44	0.4%	15-60	1472-2208	1799	yes	
	Isididae	326	2.8%	5-160	960-2716	1846	yes	2
	Isididae 2	130	1.1%	15-190	2013-2719	2522	yes	
	<i>Isidella</i> spp.	6	0.1%	20-70	1105-1823	1437	yes	
	<i>Isidella tentaculum</i>	45	0.4%	25-220	929-1409	1180	yes	1
	<i>Keratoisis</i> sp. 1 (thin branches)	108	0.9%	10-100	1586-2715	2009	yes	2
	<i>Keratoisis</i> sp. 2 (thick branches)	352	3.0%	15-270	910-2138	1466	yes	3
	<i>Lepidisis</i> spp.	447	3.8%	10-220	914-2718	2034	yes	
Black Coral	<i>Alternatipathes alternata</i>	3	0.03%	25-40	2646-2662	2656	yes	
	Antipatharia	27	0.2%	10-60	1200-2651	1545	yes	
	<i>Bathypathes patula</i>	148	1.3%	10-80	912-2718	2014	yes	2
	<i>Lillipathes</i> spp.	16	0.1%	15-60	1205-1823	1300	yes	1
	<i>Parantipathes</i> spp.	727	6.2%	10-20	1260-2647	1928	yes	1
	<i>Trissopathes</i> sp.	22	0.2%	15-70	1207-2649	1474	yes	
		<i>Umbellapathes</i> sp.	784	6.7%	10-15	1082-2719	2330	yes
Bubblegum	<i>Paragorgia arborea</i>	384	3.3%	5-130	903-2451	1331		1
	<i>Paragorgia yutlinux</i>	331	2.8%	5-90	892-1105	948	yes	2
Gorgonians	<i>Acanthogorgia</i> spp.	39	0.3%	10-50	1212-1802	1447	yes	
	Alcyonacea	72	0.6%	5-40	975-2651	1366	yes	
	<i>Psammogorgia (Swiftia) simplex</i>	177	1.5%	10-80	891-1276	991	yes	1
	<i>Psammogorgia (Swiftia) torreyi</i>	1219	10.4%	5-35	889-2155	1266	yes	4
Primnoids	<i>Callogorgia kinoshitae</i>	835	7.1%	10-50	1407-2093	1637	yes	2
	<i>Narella</i> spp.	9	0.1%	15-35	1879-2659	2540	yes	1
	<i>Parastenella ramosa</i>	327	2.8%	10-50	921-1880	1449	yes	3
	Primnoidae	3	0.03%	15-20	1202-1277	1228		
Sea Pens	<i>Distichoptilum gracile</i>	90	0.8%	10-180	1860-2542	2114	yes	1
	<i>Funiculina quadrangularis</i>	315	2.7%	5-45	959-2070	1050	yes	2
	<i>Halipteris californica</i>	869	7.4%	5-145	865-2016	1553		2
	Pennatulacea	461	3.9%	5-120	951-2730	2055		
	<i>Stachytilum superbum</i>	216	1.8%	5-30	940-2650	1137	yes	1
	<i>Umbellula lindahli</i>	9	0.1%	10-30	942-2648	1768	yes	1
		<i>Virgularia</i> spp.	182	1.5%	5-15	940-2597	1730	
Soft Coral	<i>Bathyalcyon robustum</i>	2	0.02%	10	2592-2604	2598	yes	
	<i>Clavularia</i> spp.	6	0.1%	10-50	944-2120	1634	yes	
	<i>Gersemia juliepackardae</i>	66	0.6%	5-20	889-1440	1058	yes	1
	<i>Heteropolypus ritteri</i>	2836	24.1%	5-20	866-2664	1315		
Other	<i>Radicipes stonei</i>	141	1.2%	15-150	1668-2719	2463	yes, range extension	3
	Scleractinia	2	0.02%	5-5	1404-1404	1404		
<b>TOTAL CORALS</b>		<b>11776</b>						

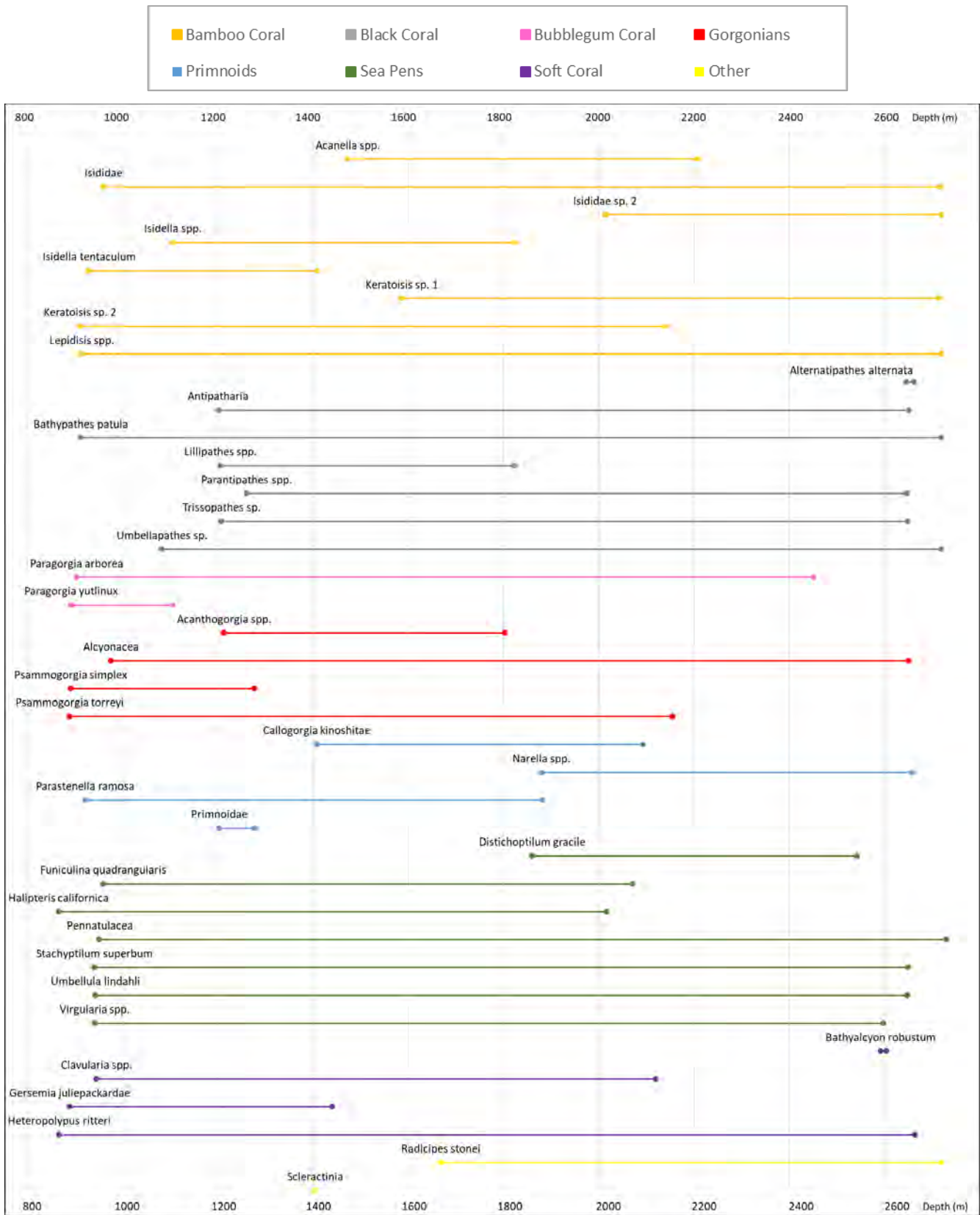


Figure 2. Depth distribution of coral taxa listed by major groups observed on all NA085 dives. Note that Scleractinia cup corals and *Virgularia* spp. sea pens are undercounted due to low detectability because of their small sizes, therefore depth distribution of these taxa may be under represented in this figure.

Table 3. Sponge taxa observed on all NA085 dives reported as total number and percent of total sponges with respective height ranges, depth ranges, if a new observation for CBNMS and number of collections made.

Common Name	Scientific Name	Total Number	Percent of Total	Height Range (cm)	Depth (m) Range	Depth (m) Average	New Species Obs for CBNMS	Num. of collections
<b>SPONGES</b>								
Demospongiae	<i>Asbestopluma</i> spp. ("pipecleaner")	192	3.5%	5-40	931-2611	1894		
	<i>Cladorhiza</i> sp.	1689	31.1%	5-20	1775-2706	2260	yes	1
	<i>Haliclona (Gellius)</i> spp.	2	0.04%	20-40	1491-2080	1785	yes	
	<i>Poecillastra</i> spp.	806	14.9%	5-50	889-2077	1230		
Hexactinellida	<i>Aphrocallistes</i> sp.	1	0.02%	20	2086	2086	yes	
	<i>Caulophacus (Caulophacus) schulzei</i>	97	1.8%	10-80	1814-2695	2414	yes, range extension	1
	<i>Caulophacus</i> cf. <i>adakensis</i>	8	0.1%	40-150	1707-2118	1876	yes, range extension	
	<i>Caulophacus</i> spp.	50	0.9%	10-80	1707-2488	1898	yes	
	<i>Farrea occa</i>	294	5.4%	5-80	889-2662	1751	yes	2
	<i>Farrea</i> sp. nov.	78	1.4%	10-40	1723-2663	2122	yes	1
	<i>Heterochone calyx</i>	387	7.1%	5-80	900-2409	1317	yes	
	<i>Hexactinella</i> spp.	16	0.3%	5-15	904-1492	989	yes	
	<i>Rhabdocalypus dawsoni</i>	1094	20.2%	10-80	889-2666	1634		1
	<i>Staurocalypus</i> spp. (yellow)	424	7.8%	10-100	900-1223	951	yes	1
<i>Staurocalypus</i> spp. (white)	32	0.6%	20-90	938-2125	1745			
Morphological	Barrel	84	1.5%	10-45	901-2220	1649		
	Foliose	14	0.3%	10-40	1202-2044	1539		
	Mound	3	0.1%	10	2012-2123	2060		
	Shelf	21	0.4%	10-40	972-2115	1728		
	Upright Flat	15	0.3%	10-40	1410-2159	1819		
	Vase	115	2.1%	10-50	895-2694	1784		
<b>TOTAL SPONGES</b>		<b>5423</b>						

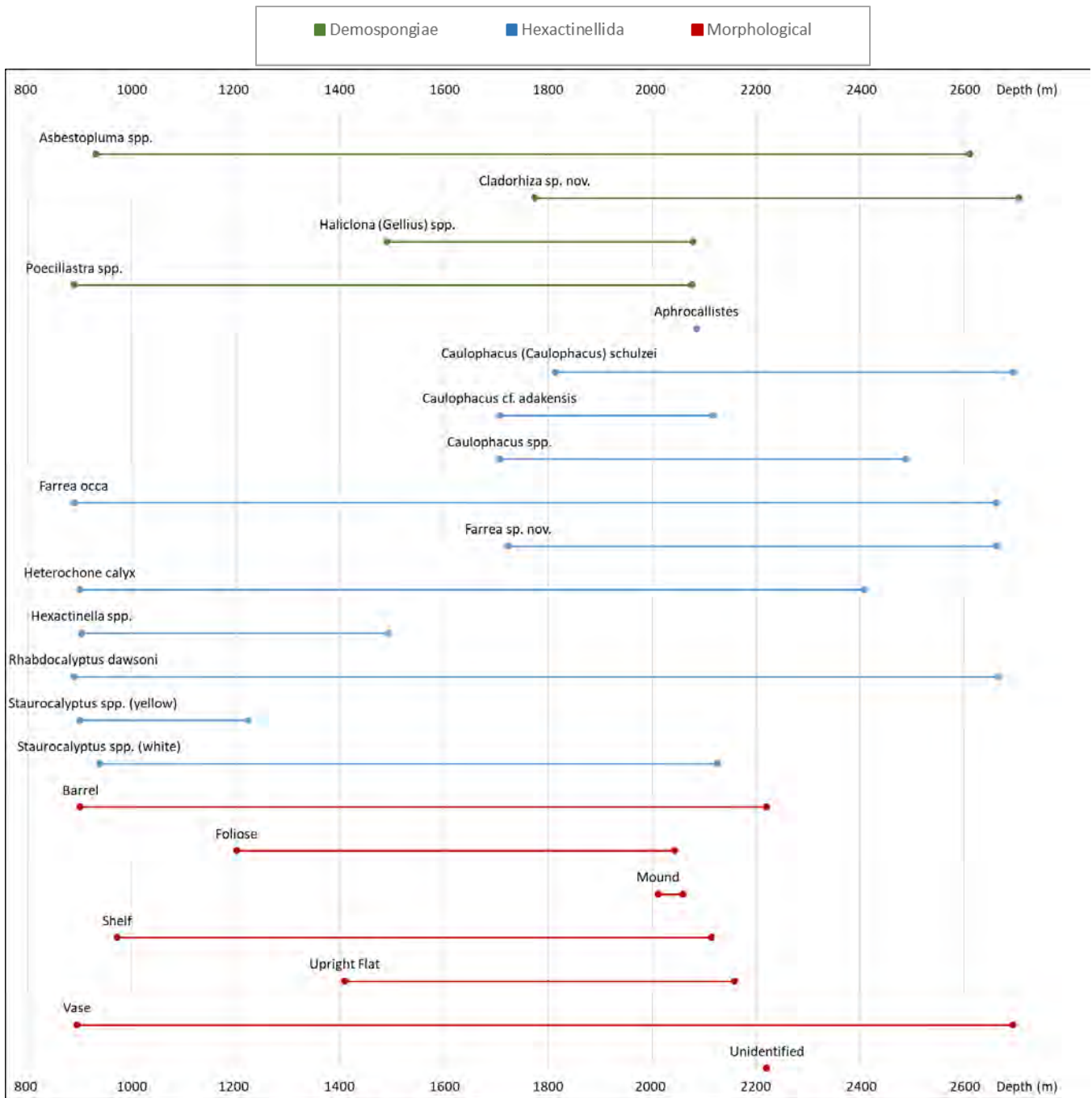


Figure 3. Depth distribution of sponge taxa listed by major groups observed on all NA085 dives.



Table 4 lists all of the fish taxa observed on the six dives in CBNMS. Taxa are organized by major groups with accompanying data about total counts, percent of total fish, depth ranges, and if the taxa were previously undocumented in CBNMS. At least 31 taxa of fish from 16 families were observed. Eight of these taxa are new species observations for CBNMS. The other known species (listed in the 2014 CBNMS Management Plan) had previously been collected by National Marine Fisheries Service trawl surveys but it should be noted that these are the first in situ visual observations for the majority of these fish species.

Table 4. Fish taxa observed on all NA085 dives reported as total number and percent of total fish with respective depth ranges and noted if a new observation for CBNMS.

Group	Family	Scientific Name	Common Name	Total	Percent of Total	Depth (m) Range	New Species Obs for CBNMS
Catshark	Pentanchidae	<i>Apristurus brunneus</i>	Brown catshark	1	0.02%	961	
		<i>Apristurus kampae</i>	Longnose catshark	1	0.02%	998	
Eelpout	Zoarcidae	<i>Bothrocara brunneum</i>	Twoline eelpout	23	0.5%	985-2733	
		<i>Lycenchelys crotalinus</i>	Snakehead eelpout	124	3%	867-1186	
		<i>Lycenchelys</i> spp.	Eelpout	144	3%	952-2202	
		<i>Lycodapus</i> spp.	Eelpout	226	5%	864-1186	
		Unknown Zoarcidae	Unidentified eelpout	287	6%	865-2732	
Flatfish	Pleuronectidae	<i>Embassichthys bathybius</i>	Deepsea sole	142	3%	884-1408	
		<i>Microstomus pacificus</i>	Dover sole	84	2%	865-1288	
		Unknown Pleuronectidae	Unidentified flatfishes	24	0.5%	927-1174	
Grenadier	Macrouridae	Unknown Macrouridae	Unidentified grenadier	1227	25%	963-2736	
Morids	Moridae	<i>Antimora microlepis</i>	Finescale mora/Pacific flatnose	104	2%	1062-2737	
		<i>Physiculus rastrelliger</i>	100 fathom codling	1	0.02%	1082	yes
Rockfish	Scorpaenidae	<i>Sebastolobus alascanus</i>	Shortspine thornyhead	37	1%	888-1291	
		<i>Sebastolobus altivelas</i>	Longspine thornyhead	59	1%	879-1409	
		<i>Sebastolobus</i> spp.	Unidentified thornyheads	2109	44%	865-1595	
Skate	Arhynchobatidae	<i>Bathyraja aleutica</i>	Aleutian skate	4	0.1%	1777-2495	yes
		<i>Bathyraja spinosissima</i>	White skate	8	0.2%	1368-2625	yes
	Rajidae	<i>Bathyraja trachura</i>	Roughtail skate	25	1%	891-1835	yes
		<i>Raja</i> spp.	Unidentified skate	4	0.1%	985-2657	
Snailfish	Liparididae	<i>Careproctus kamikawai</i>	Arbiter snailfish	20	0.4%	869-2129	yes
		<i>Careproctus melanurus</i>	Blacktail snailfish	13	0.3%	866-1827	
		<i>Careproctus ovigerus</i>	Abyssal snailfish	3	0.1%	2663-2674	yes
		Unidentified Liparididae	Unidentified snailfish	24	0.5%	891-2737	
Other	Agonidae	Agonidae	Unidentified poacher	13	0.3%	1017-1596	
	Alepocephalidae	<i>Alepocephalus tenebrosus</i>	California slickhead	18	0.4%	890-1596	
	Anoplopomatidae	<i>Anoplopoma fimbria</i>	Sablefish	29	1%	881-1427	
	Cottidae	<i>Psychrolutes phrictus</i>	Blob sculpin	4	0.1%	1283-1748	yes
	Myxiniidae	<i>Eptatretus</i> sp.	Hagfish	57	1%	882-1217	
	Ophidiidae	Ophidiidae	Unidentified cuskeel	3	0.1%	1517-1706	
	Synphobranchidae	<i>Synphobranchus</i> sp	Cutthroat eel	1	0.02%	1984	yes
<b>TOTAL FISH</b>				<b>4819</b>			

## SUMMARY OF DIVE H1625 – Bodega Canyon I

### H1625 Dive Details

ROV details:		CTD (on bottom) details:	
Date Time ROV in water (UTC)	8/7/17 12:42 AM	Average Temperature (c)	2.2
Date Time ROV on deck (UTC)	8/7/17 9:57 PM	Minimum Temperature (c)	1.9
Date Time ROV on bottom (UTC)	8/7/17 2:18 AM	Maximum Temperature (c)	3.2
Date Time ROV off bottom (UTC)	8/7/17 8:16 PM	Average O2 Concentration (ml/L)	1.5
ROV Maximum Depth (m)	2207	Minimum O2 Concentration (ml/L)	1.1
ROV Off Bottom Depth (m)	1660	Maximum O2 Concentration (ml/L)	1.9
ROV Average Depth (m)	1870	Average O2 Saturation (%)	15.1
Total Dive Time (hrs)	21.25	Minimum O2 Saturation (%)	11.6
Total Bottom Time (hrs)	17.96	Maximum O2 Saturation (%)	19.3

### H1625 Collections (corals and sponges)

# Sample ID	CAS IZ#	Genus/FAMILY/HIGHER TAXON	Species	Date Time (UTC)	Latitude	Longitude	Depth (m)	Temp (c)	Salinity	O2 Conc.
NA085-002	223581	<i>Parantipathes</i>		8/7/2017 4:19	38.2050	-123.7045	2126	2.0	34.6	78.4
NA085-004	220948	<i>Keratoisis</i>	sp. 1	8/7/2017 4:36	38.2048	-123.7045	2124	2.0	34.6	78.5
NA085-005	223280	<i>Cladorhiza</i>		8/7/2017 5:15	38.2051	-123.7043	2092	2.0	34.6	78.7
NA085-006	220963	<i>Distichoptilum</i>	<i>gracile</i>	8/7/2017 6:32	38.2068	-123.7025	1990	2.1	34.6	74.1
NA085-007	220961	<i>Halipteris</i>	<i>californica</i>	8/7/2017 6:39	38.2068	-123.7024	1990	2.0	34.6	74.0
NA085-009	220968	<i>Callogorgia</i>	<i>kinoshitae</i>	8/7/2017 9:29	38.2130	-123.6891	1815	2.1	34.6	71.2
NA085-011	N/A	dead bamboo coral		8/7/2017 11:48	38.2127	-123.6852	1824	2.2	34.6	66.7
NA085-012	220949	<i>Keratoisis</i>	sp. 2	8/7/2017 12:52	38.2137	-123.6833	1827	2.3	34.6	58.5
NA085-013	223592	<i>Farrea</i>		8/7/2017 17:29	38.2152	-123.6654	1706	2.5	34.6	51.3
NA085-014	220978	<i>Parastenella</i>	<i>ramosa</i>	8/7/2017 17:42	38.2152	-123.6654	1708	2.4	34.6	51.0
NA085-016	220952	Isididae	g. & sp. indet	8/7/2017 18:24	38.2169	-123.6664	1713	2.4	34.6	50.6
NA085-018	223585	HYDROIDOLINA		8/7/2017 19:17	38.2183	-123.6674	1677	2.4	34.6	52.1
NA085-019	220977	<i>Parastenella</i>	<i>ramosa</i>	8/7/2017 19:21	38.2183	-123.6674	1673	2.4	34.6	52.4
NA085-020	220971	<i>Parastenella</i>	<i>ramosa</i>	8/7/2017 19:39	38.2181	-123.6677	1678	2.4	34.6	53.4

### Other taxa and other collections

- Four Niskin water samples and three sediment push cores were collected on H1625
- Other taxa identified from samples include: Ophiuroidea, Pectinidae, Harmothoe cf. fragilis
- Two species (undetermined) of *Keratoisis* bamboo corals were collected, sp. 1 has thin branches and sp. 2 has thick branches.

## H1625 Coral and Sponge Observations from Video

Common Name	Scientific Name	Total Number	Percent of Total	Height Range (cm)	Depth (m) Range
<b>CORALS</b>					
Bamboo Coral	<i>Acanella</i> spp.	36	1.5%	15-60	1680-1828
	Isididae	132	5.6%	10-80	1677-2157
	Isididae 2 (pos. branching <i>Lepidisis</i> spp.)	3	0.1%	30-80	2124-2169
	<i>Isidella</i> spp.	1	0.04%	35	1823
	<i>Keratoisis</i> sp. 1 (thin branches)	92	3.9%	10-100	1748-2166
	<i>Keratoisis</i> sp. 2 (thick branches)	44	1.9%	20-140	1722-2033
	<i>Lepidisis</i> spp.	96	4.1%	20-220	1700-2171
Black Coral	<i>Antipatharia</i>	4	0.2%	15	1825-1831
	<i>Bathypathes patula</i>	71	3.0%	15-80	1679-2150
	<i>Lillipathes</i> spp.	1	0.0%	15	1823
	<i>Parantipathes</i> spp.	166	7.1%	10-25	1806-2153
	<i>Trissopathes</i> spp.	2	0.1%	25	1829-2041
	<i>Umbellapathes</i> sp.	148	6.3%	10-15	1824-2168
Bubblegum	<i>Paragorgia arborea</i>	4	0.2%	15-50	1720-2144
Gorgonians	<i>Acanthogorgia</i> spp.	5	0.2%	15-30	1702-1802
	Alcyonacea	8	0.3%	10-40	1701-1820
	<i>Psammogorgia (Swiftia) torreyi</i>	43	1.8%	10-30	1775-2155
Primnoids	<i>Callogorgia kinoshitae</i>	302	12.9%	10-50	1747-2041
	<i>Narella</i> spp.	1	0.04%	15	1879
	<i>Parastenella ramosa</i>	120	5.1%	10-50	1673-1880
Sea Pens	<i>Distichoptilum gracile</i>	29	1.2%	25-180	1860-2007
	<i>Halipterus californica</i>	270	11.5%	15-100	1774-2016
	Pennatulacea	196	8.4%	5-120	1774-2206
	<i>Stachytilum superbum</i>	14	0.6%	10-30	1804-2204
	<i>Umbellula lindahli</i>	1	0.04%	30	2137
	<i>Virgularia</i> spp.	122	5.2%	5-15	1775-2025
Soft Coral	<i>Clavularia</i> spp.	2	0.1%	15-20	1720-2032
	<i>Heteropolypus ritteri</i>	429	18.3%	5-20	1700-2005
Other	<i>Radicipes stonei</i>	1	0.04%	50	1668
<b>TOTAL CORALS</b>		<b>2343</b>			
<b>SPONGES</b>					
Demospongiae	<i>Asbestopluma</i> spp. ("pipecleaner")	22	2.5%	10-40	1813-2109
	<i>Cladorhiza</i> sp.	364	40.6%	5-20	1775-2137
	<i>Haliclona (Gellius) spp.</i>	1	0.1%	20	2080
	<i>Poecillastra</i> spp.	116	12.9%	5-30	1676-2077
Hexactinellida	<i>Aphrocallistes</i> sp.	1	0.1%	20	2086
	<i>Caulophacus (Caulophacus) schulzei</i>	36	4.0%	10-30	1814-2185
	<i>Caulophacus cf. adakensis</i>	7	0.8%	40-150	1707-2032
	<i>Caulophacus</i> spp.	32	3.6%	15-80	1707-1830
	<i>Farrea occa</i>	138	15.4%	10-80	1703-2159
	<i>Farrea</i> sp. nov.	18	2.0%	10-40	1723-2123
	<i>Heterochone calyx</i>	28	3.1%	10-15	1677-2168
	<i>Rhabdocalyptus dawsoni</i>	42	4.7%	10-80	1692-2109
	<i>Staurocalyptus</i> spp. (white)	10	1.1%	20-45	1681-2100
Morphological	Barrel	21	2.3%	10-40	1699-1824
	Foliose	3	0.3%	15-40	1747-2044
	Mound	3	0.3%	10	2012-2123
	Shelf	11	1.2%	10-20	1720-1827
	Upright Flat	5	0.6%	15-40	1707-2159
	Vase	38	4.2%	10-50	1678-2145
<b>TOTAL SPONGES</b>		<b>896</b>			

## H1625 Fish Observations from Video

Group	Family	Scientific Name	Common Name	Total	Percent of Total	Depth (m) Range
Eelpout	Zoarcidae	<i>Bothrocara brunneum</i>	Twoline eelpout	4	1%	1707-2012
		<i>Lycenchelys</i> spp.	Eelpout	2	1%	2202
		<i>Lycodapus</i> spp.	Eelpout	9	3%	1670-1956
		Unknown Zoarcidae	Unidentified eelpout	39	13%	1704-2205
Grenadier	Macrouridae	Unknown Macrouridae	Unidentified grenadier	184	64%	1671-2206
Morids	Moridae	<i>Antimora microlepis</i>	Finescale mora/Pacific flatnose	33	11%	1702-2206
Skate	Arhynchobatidae	<i>Bathyraja aleutica</i>	Aleutian skate	3	1%	1776-1854
	Rajidae	<i>Bathyraja trachura</i>	Roughtail skate	1	0.3%	1835
Snailfish	Liparididae	<i>Careproctus kamikawai</i>	Arbiter snailfish	2	1%	1703-1704
		<i>Careproctus melanurus</i>	Blacktail snailfish	4	1%	1681-1827
Other	Anoplopomatidae	<i>Anoplopoma fimbria</i>	Sablefish	4	1%	1704-1863
	Cottidae	<i>Psychrolutes phrictus</i>	Blob sculpin	2	1%	1704-1748
	Ophidiidae	Ophidiidae	Unidentified cuskeel	1	0.3%	1706
	Synphobranchidae	<i>Synphobranchus</i> sp	Cutthroat eel	1	0.3%	1984
<b>TOTAL FISH</b>				<b>289</b>		

Other observations: 44 *Graneledone boreopacifica* octopus, four observations of marine debris: plastic bottle, boat fender, garbage bag, and a metal pipe.

## Description of H1625

H1625, Bodega Canyon I, had a maximum bottom depth of 2,207 meters and a minimum bottom depth of 1,660 meters. The habitat types consisted of large expanses of mud and a few areas with impressive, vertical rock walls. On the mud bottom, sea pens were the dominant coral and 89% (n=239) of *Halipteris californica* had associated serpent stars, *Asteronyx* spp. Also to note is that *Virgularia* spp. sea pens are undercounted due to their small size (5-15 cm) and the ROV typically flying high over the seafloor reduces their detectability. Of the 71 total *Bathypathes patula* counted, 13 (or 18% of total) were documented in a dead or dying condition. Two species of *Keratoisis* bamboo corals were observed: *Keratoisis* sp. 1 has thin branches and *Keratoisis* sp. 2 has thick branches. There was a noticeable transition of the two *Keratoisis* types based on depth. The abundance of thin branched *Keratoisis* sp. 1 was greater at deeper depths and the abundance of the thick branched *Keratoisis* sp. 2 increased as depths decreased. The single stalked bamboo coral, *Lepidisis* spp., were often very tall, reaching up to 220 cm. *Keratoisis* sp. 2 favor growing on vertical walls, oriented perpendicular to the walls. When the ROV reached the top of the wall (the plateau) *Keratoisis* sp. 2 were not present. This could be due to stronger water currents hitting the wall face and the corals are capitalizing on nutrient delivery.

Also observed were very large (maximum height recorded 150 cm) mushroom-shaped sponges (n=7) on a long cylindrical stalk (*Caulophacus* spp.) that could be *Caulophacus* cf. *adakensis*, which would be a range extension from the Aleutian Islands, Alaska (Bob Stone, pers. comm.); a sample is needed to confirm identification. Continuing up slope to areas consisting of mud with boulders and mud covered (vener) rock the dominant coral was the primnoid, *Callogorgia kinoshitae*. They were often very dense on the few rocks scattered among the mud dominated bottom and 92% (n=277) of all individuals had associated *Asteronyx* spp. Areas of rock with a mud veneer were the preferred habitat for the sponge, *Cladorhiza* sp., that are small in size (and therefore are undercounted) but were the most

abundant of the sponge taxa (41% of total sponges). The first observations of the flat morphology *Farrea* sp. nov. were seen on this dive. As depths further decreased the abundant coral was the gorgonian, *Parastenella ramosa*, and fringed shelf sponges, *Poecillastra* spp., were also abundant.

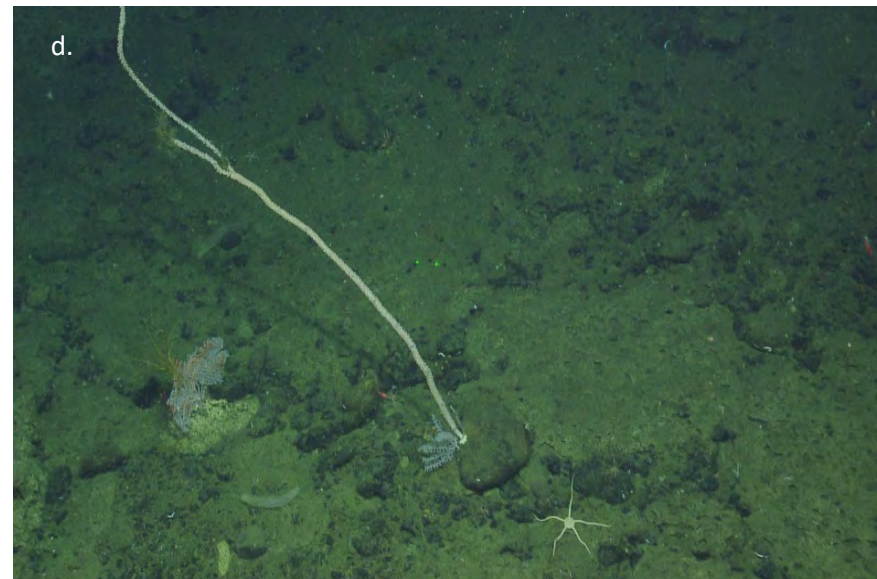
Towards the end of the dive at 1700 m there were fewer bamboo corals living on the rock walls. Many of the rocky areas at this depth were composed of piles of cobbles and boulders. Some of these areas look like landslides deposits and the loose rubble habitat is not ideal for the establishment of sessile sponges and corals.

Another interesting observation on H1625 was a high abundance of *Graneledone boreopacifica* octopus (n=29) observed within a limited depth band of about 40 meters (specifically 1680-1720 meters). These octopus are most likely brooding as individuals were not moving, attached close to rocks, and two females had eggs visible under them. Researchers from the Monterey Bay Aquarium Research Institute (MBARI) documented a female *Graneledone boreopacifica* in Monterey Canyon brooding her eggs for a record 53 months (over 4 years), making this the longest brooding or pregnancy period known in the animal kingdom. This also makes it the longest living octopus since most octopuses only live for 1 or 2 years, which this octopus beats with its brooding period alone<sup>3</sup>. There was one observation of a *Graneledone* sp. octopus that was all white.

The most abundant fish observed on H1625 were Grenadiers and Pacific flatnose (*Antimora microlepis*). Grenadiers are very difficult to identify from video imagery and were therefore all classified as unknown Macrouridae. The potential species known for the area are Giant grenadier (*Albatrossia pectoralis*), Threadfin grenadier (*Coryphaenoides filifer*), and Pacific grenadier (*Coryphaenoides acrolepis*).

<sup>3</sup>Robison B., Seibel B., Drazen J. (2014), Deep-sea octopus (*Graneledone boreopacifica*) conducts the longest-known egg-brooding period of any animal. *PLoS ONE*9(7): e103437. doi:10.1371/journal.pone.0103437

## Representative pictures of H1625



(a.) Mushroom-shaped sponge on a long cylindrical stalk (*Caulophacus* cf. *adakensis*) (b.) Brooding *Graneledone boreopacifica* octopus were seen hiding under rocks on canyon wall (c.) Sponge, *Cladorhiza* sp. (d.) Stalked bamboo corals, *Lepidisis* spp., were often very tall and notice that this individual is branched at the top.

## SUMMARY OF DIVE H1626 – Bodega Canyon II

### H1626 Dive Details

ROV details:		CTD (on bottom) details:	
Date Time ROV in water (UTC)	8/8/17 3:08 AM	Average Temperature (c)	2.9
Date Time ROV on deck (UTC)	8/8/17 8:59 PM	Minimum Temperature (c)	2.6
Date Time ROV on bottom (UTC)	8/8/17 4:13 AM	Maximum Temperature (c)	3.8
Date Time ROV off bottom (UTC)	8/8/17 7:31 PM	Average O2 Concentration (ml/L)	0.7
ROV Maximum Depth (m)	1599	Minimum O2 Concentration (ml/L)	0.3
ROV Off Bottom Depth (m)	1205	Maximum O2 Concentration (ml/L)	1.0
ROV Average Depth (m)	1394	Average O2 Saturation (%)	7.4
Total Dive Time (hrs)	17.85	Minimum O2 Saturation (%)	3.3
Total Bottom Time (hrs)	15.29	Maximum O2 Saturation (%)	10.3

### H1626 Collections (corals and sponges)

# Sample ID	CAS IZ#	Genus/FAMILY/HIGHER TAXON	Species	Date Time (UTC)	Latitude	Longitude	Depth (m)	Temp (c)	Salinity	O2 Conc.
NA085-023	222828	<i>Callogorgia</i>	<i>kinoshitae</i>	8/8/2017 5:29	38.2329	-123.6608	1526	2.8	34.5	35.0
NA085-025	220954	<i>Psammogorgia (Swiftia)</i>	<i>torreyi</i>	8/8/2017 6:45	38.2335	-123.6553	1436	3.0	34.5	28.4
NA085-026	220972	Isididae	g. & sp. indet	8/8/2017 8:49	38.2262	-123.6429	1508	2.6	34.5	42.6
NA085-027	220959	<i>Psammogorgia (Swiftia)</i>	<i>torreyi</i>	8/8/2017 9:05	38.2264	-123.6428	1512	2.6	34.5	43.1
NA085-028	220965	<i>Paragorgia</i>	<i>arborea</i>	8/8/2017 9:13	38.2263	-123.6427	1512	2.6	34.5	43.6
NA085-029	N/A	dead bamboo coral		8/8/2017 11:22	38.2277	-123.6416	1422	2.7	34.5	39.3
NA085-031	N/A	dead bamboo coral		8/8/2017 12:25	38.2277	-123.6398	1403	2.7	34.5	37.0
NA085-032	220955	<i>Psammogorgia (Swiftia)</i>	<i>torreyi</i>	8/8/2017 12:49	38.2276	-123.6391	1414	2.8	34.5	35.6
NA085-033	223225	<i>Keratoisis</i>	sp. 2	8/8/2017 13:28	38.2278	-123.6385	1397	2.8	34.5	33.6
NA085-035	N/A	dead bamboo coral		8/8/2017 14:05	38.2281	-123.6374	1410	2.9	34.5	32.6
NA085-037	220960	PRIMNOIDAE		8/8/2017 18:38	38.2325	-123.6207	1203	3.5	34.5	15.1

### Other taxa and other collections

- Six Niskin water samples and two sediment push cores were collected on H1626
- Associated taxa identified from samples include: Pycnogonida, Paradyte, Cirripedia

## H1626 Coral and Sponge Observations from Video

Common Name	Scientific Name	Total Number	Percent of Total	Height Range (cm)	Depth (m) Range
<b>CORALS</b>					
Bamboo Coral	<i>Acanella</i> spp.	2	0.1%	25-35	1472-1499
	Isididae	45	1.4%	5-80	1196-1586
	<i>Isidella</i> spp.	3	0.1%	20-70	1404-1439
	<i>Isidella tentaculum</i>	22	0.7%	35-160	1197-1409
	<i>Keratoisis</i> sp. 1 (thin branches)	1	0.03%	80	1586
	<i>Keratoisis</i> sp. 2 (thick branches)	147	4.5%	15-270	1196-1424
	<i>Lepidisis</i> spp.	131	4.0%	10-180	1200-1586
Black Coral	Antipatharia	2	0.1%	30	1200-1415
	<i>Bathypathes patula</i>	3	0.1%	20-40	1398-1507
	<i>Lillipathes</i> spp.	6	0.2%	20-60	1205-1419
	<i>Parantipathes</i> spp.	178	5.4%	10	1400-1497
	<i>Trissopathes</i> sp.	2	0.1%	35-50	1207-1408
Bubblegum	<i>Paragorgia arborea</i>	271	8.3%	5-130	1196-1518
Gorgonians	<i>Acanthogorgia</i> spp.	33	1.0%	10-50	1356-1421
	Alcyonacea	47	1.4%	5-30	1196-1491
	<i>Psammogorgia (Swiftia) simplex</i>	3	0.1%	20-80	1201-1220
	<i>Psammogorgia (Swiftia) torreyi</i>	682	20.9%	5-25	1196-1518
Primnoids	<i>Callogorgia kinoshitae</i>	531	16.2%	10-50	1407-1597
	<i>Parastenella ramosa</i>	160	4.9%	10-40	1196-1559
	Primnoidae	2	0.1%	15-20	1202-1205
Sea Pens	<i>Halipteris californica</i>	501	15.3%	10-145	1316-1597
	Pennatulacea	36	1.1%	15-50	1419-1593
	<i>Stachytilum superbum</i>	2	0.1%	20-25	1539-1567
	<i>Virgularia</i> spp.	11	0.3%	10	1589-1598
Soft Coral	<i>Gersemia juliepackardae</i>	21	0.6%	5-20	1202-1440
	<i>Heteropolypus ritteri</i>	426	13.0%	5-20	1194-1582
Other	Scleractinia	2	0.1%	5	1404
<b>TOTAL CORALS</b>		<b>3270</b>			
<b>SPONGES</b>					
Demospongiae	<i>Asbestopluma</i> spp. ("pipecleaner")	2	0.3%	15-20	1225-1425
	<i>Haliclona (Gellius)</i> spp.	1	0.1%	40	1491
	<i>Poecillastra</i> spp.	258	38.7%	5-40	1197-1519
Hexactinellida	<i>Farrea occa</i>	77	11.5%	10-40	1196-1591
	<i>Heterochone calyx</i>	160	24.0%	5-50	1198-1585
	<i>Hexactinella</i> spp.	1	0.15%	10	1492
	<i>Rhabdocalypus dawsoni</i>	123	18.4%	10-45	1198-1581
	<i>Staurocalypus</i> spp. (yellow)	2	0.3%	40	1221-1223
	<i>Staurocalypus</i> spp. (white)	4	0.6%	20-40	1400-1493
Morphological	Barrel	11	1.6%	15-20	1403-1507
	Foliose	11	1.6%	10-30	1202-1586
	Shelf	4	0.6%	10-30	1404-1413
	Upright Flat	6	0.9%	10-25	1410-1425
	Vase	7	1.0%	10-20	1450-1503
<b>TOTAL SPONGES</b>		<b>667</b>			



## H1626 Fish Observations from Video

Group	Family	Scientific Name	Common Name	Total	Percent of Total	Depth (m) Range
Eelpout	Zoarcidae	<i>Bothrocara brunneum</i>	Twoline eelpout	5	0.4%	1206-1516
		<i>Lycodapus</i> spp.	Eelpout	59	5%	1317-1594
		Unknown Zoarcidae	Unidentified eelpout	114	10%	1211-1598
Flatfish	Pleuronectidae	<i>Embassichthys bathybius</i>	Deepsea sole	12	1%	1203-1408
Grenadier	Macrouridae	Unknown Macrouridae	Unidentified grenadier	769	67%	1198-1598
Morids	Moridae	<i>Antimora microlepis</i>	Finescale mora/Pacific flatnose	22	2%	1336-1596
Rockfish	Scorpaenidae	<i>Sebastolobus alascanus</i>	Shortspine thornyhead	3	0.3%	1205-1286
		<i>Sebastolobus altivelas</i>	Longspine thornyhead	4	0.3%	1207-1409
		<i>Sebastolobus</i> spp.	Unidentified thornyheads	119	10%	1193-1595
Skate	Arhynchobatidae	<i>Bathyraja spinosissima</i>	White skate	6	0.5%	1368-1454
	Rajidae	<i>Bathyraja trachura</i>	Roughtail skate	4	0.3%	1198-1337
Snailfish	Liparididae	<i>Careproctus kamikawai</i>	Arbiter snailfish	5	0.4%	1198-1413
		<i>Careproctus melanurus</i>	Blacktail snailfish	6	0.5%	1318-1454
		<i>Liparididae</i>	Unidentified snailfish	3	0.3%	1407-1490
Other	Agonidae	Agonidae	Unidentified poacher	3	0.3%	1596
	Alepocephalidae	<i>Alepocephalus tenebrosus</i>	California slickhead	2	0.2%	1356-1596
	Anoplopomatidae	<i>Anoplopoma fimbria</i>	Sablefish	8	0.7%	1200-1427
	Cottidae	<i>Psychrolutes phrictus</i>	Blob sculpin	1	0.1%	1516
	Myxinidae	<i>Eptatretus</i> sp.	Hagfish	2	0.2%	1206-1217
	Ophidiidae	Ophidiidae	Unidentified cuskeel	2	0.2%	1517-1596
<b>TOTAL FISH</b>				<b>1149</b>		

Other observations: 27 *Graneledone boreopacifica* octopus, two observations of thick rope.

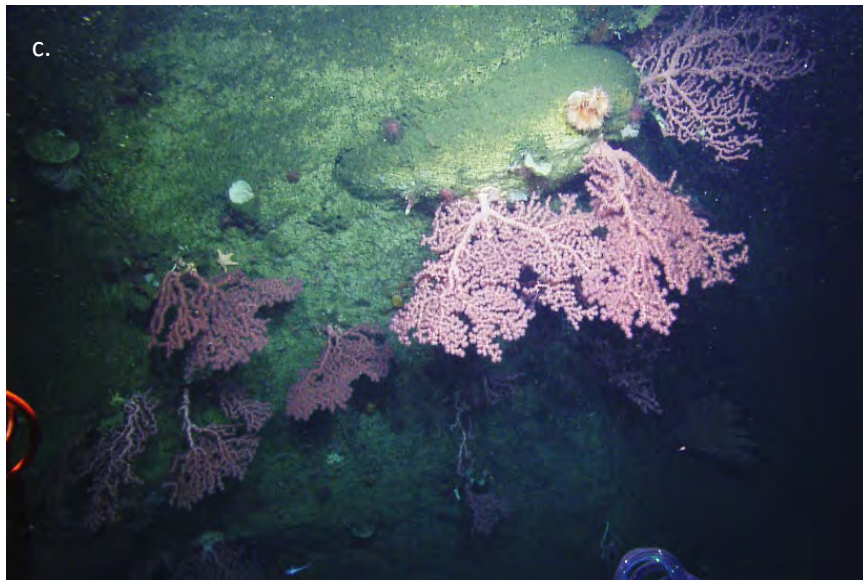
## Description of H1626

H1626, Bodega Canyon II, had a maximum bottom depth of 1,599 meters and a minimum bottom depth of 1,205 meters. The deepest part of this dive begins at the shallowest depths the first Bodega Canyon dive (H1625) ended. A notable observation is the thick branched *Keratoisis* sp. 2 is more abundant than was observed on H1625. Additionally, the thin branched *Keratoisis* sp. 1 is nearly absent (n=1) on this dive while it was very common at the deeper depths of H1625. Many of the *Keratoisis* sp. 2 are very large, living as groups, reaching a maximum height of 270 m. The other type of large bamboo coral, *Isidella tentaculum*, is seen for the first time on this dive. It appears that both *Isidella tentaculum* and *Keratoisis* sp. 2 grow on distinct ridgelines on the canyon walls that are solid rock structures (not mixed loose rock habitats). The fan shaped gorgonian, *Psammogorgia (Swiftia) torreyi*, is very abundant and accounts for nearly 21% of all coral counts, occurring at depths similar to those preferred by *Isidella tentaculum*. Significantly fewer *Bathypathes patula* black corals (n=3) were observed on this dive than on deeper dive H1625 (n=71). *Parantipathes* spp. are the dominant of the black coral taxa. Bubblegum corals, *Paragorgia arborea*, were found at the highest abundances on this dive than on any other NA085 dive and were often living in dense groups of large sized individuals (n=271; 8% of total corals). The primnoid, *Callogorgia kinoshitae*, had the second highest percent of total coral counts as was the case on dive H1625 suggesting that this species is very common at the range of depths surveyed by both H1625 and H1626 dives.

A notable observation about the goiter sponges, *Heterochore calyx*, is that 70% (n=121) of all individuals on this dive were documented as dead or dying. They were upright but covered in sediment. The new species of flat morphology *Farrea* sp. nov. was not observed on this dive, therefore providing valuable information of the deeper depth distribution for this new species.

The most abundant fish observed on H1626 were Grenadiers and Thornyhead rockfish including Shortspine (*Sebastolobus alascanus*) and Longspine (*Sebastolobus altivelas*), however most of the individuals were identified as *Sebastolobus* spp.

## Representative pictures of H1626



(a.) Very large *Keratoisis* sp. 2 growing perpendicular to canyon rock walls (b.) *Isidella tentaculum* bamboo coral (c.) Bubblegum coral *Paragorgia arborea* growing perpendicular to canyon rock walls (d.) The primnoid, *Callogorgia kinoshitae*, on the left (pink) and the fan-shaped gorgonian *Psammogorgia (Swiftia) torreyi* on the right (red)

## SUMMARY OF DIVE H1627 – Box Canyon

### H1627 Dive Details

ROV details:		CTD (on bottom) details:	
Date Time ROV in water (UTC)	8/9/17 1:06 AM	Average Temperature (c)	1.6
Date Time ROV on deck (UTC)	8/10/17 2:00 AM	Minimum Temperature (c)	1.7
Date Time ROV on bottom (UTC)	8/9/17 3:01 AM	Maximum Temperature (c)	2.7
Date Time ROV off bottom (UTC)	8/9/17 11:43 PM	Average O2 Concentration (ml/L)	2.0
ROV Maximum Depth (m)	2737	Minimum O2 Concentration (ml/L)	1.5
ROV Off Bottom Depth (m)	1976	Maximum O2 Concentration (ml/L)	2.4
ROV Average Depth (m)	2344	Average O2 Saturation (%)	21.1
Total Dive Time (hrs)	24.91	Minimum O2 Saturation (%)	15.9
Total Bottom Time (hrs)	20.7	Maximum O2 Saturation (%)	25.1

### H1627 Collections (corals and sponges)

# Sample ID	CAS IZ#	Genus/FAMILY/HIGHER TAXON	Species	Date Time (UTC)	Latitude	Longitude	Depth (m)	Temp (c)	Salinity	O2 Conc.
NA085-041	223579	<i>Umbellapathes</i>		8/9/2017 4:20	38.0881	-123.7022	2639	1.71	34.64	106.04
NA085-042	207516	<i>Radicipes</i>	<i>stonei</i>	8/9/2017 4:35	38.0878	-123.7023	2646	1.71	34.64	105.09
NA085-043	220966	<i>Narella</i>		8/9/2017 4:50	38.0874	-123.7023	2647	1.76	34.63	105.34
NA085-045	223283	<i>Caulophacus</i>	<i>schulzei</i>	8/9/2017 5:14	38.0874	-123.7024	2648	1.74	34.63	106.31
NA085-046	220969	<i>Keratoisis</i>	sp. 1	8/9/2017 6:01	38.0872	-123.7027	2680	1.77	34.63	106.40
NA085-048	207517	<i>Radicipes</i>	<i>stonei</i>	8/9/2017 7:46	38.0877	-123.6954	2630	1.74	34.64	102.53
NA085-049	223582	<i>Bathypathes</i>		8/9/2017 16:24	38.1099	-123.6579	2204	1.85	34.62	89.30
NA085-050	223281	<i>Farrea</i>		8/9/2017 17:58	38.1113	-123.6583	2120	1.94	34.59	83.85
NA085-052	223595	<i>Rhabdocalyptus</i>	<i>dawsoni</i>	8/9/2017 18:20	38.1114	-123.6582	2113	1.92	34.61	83.77
NA085-054	220964	<i>Funiculina</i>	<i>quadrangularis</i>	8/9/2017 21:25	38.1093	-123.6438	2070	1.98	34.63	78.28
NA085-055	207518	<i>Radicipes</i>	<i>stonei</i>	8/9/2017 21:37	38.1099	-123.6436	2072	1.97	34.61	79.35

### Other taxa and other collections

- Five Niskin water samples and one sediment push core were collected on H1627
- Other associated taxa identified from samples include: Ophiuroidea, Tjalfiellidae

## H1627 Coral and Sponge Observations from Video

Common Name	Scientific Name	Total Number	Percent of Total	Height Range (cm)	Depth (m) Range
<b>CORALS</b>					
Bamboo Coral	<i>Acanella</i> spp.	6	0.2%	20-60	2119-2208
	Isididae	107	3.2%	10-160	2031-2716
	Isididae 2 (pos. branching <i>Lepidisis</i> spp.)	127	3.8%	15-190	2013-2719
	<i>Keratoisis</i> sp. 1 (thin branches)	15	0.4%	20-70	2078-2715
	<i>Keratoisis</i> sp. 2 (thick branches)	37	1.1%	40-140	2038-2138
	<i>Lepidisis</i> spp.	216	6.4%	10-140	2028-2718
Black Coral	<i>Alternatipathes alternata</i>	3	0.1%	25-40	2646-2662
	Antipatharia	6	0.2%	15	2079-2651
	<i>Bathypathes patula</i>	71	2.1%	15-60	1987-2718
	<i>Parantipathes</i> spp.	381	11.3%	10-20	2013-2647
	<i>Trissopathes</i> spp.	3	0.1%	15-70	2084-2649
	<i>Umbellapathes</i> sp.	635	18.9%	10-15	1987-2719
Bubblegum	<i>Paragorgia arborea</i>	5	0.1%	20-35	2121-2451
Gorgonians	Alcyonacea	1	0.03%	15	2651
	<i>Psammogorgia (Swiftia) torreyi</i>	3	0.1%	15	2119-2133
Primnoids	<i>Callogorgia kinoshitae</i>	2	0.1%	20-40	2091-2093
	<i>Narella</i> spp.	8	0.2%	15-35	2646-2659
Sea Pens	<i>Distichoptilum gracile</i>	61	1.8%	10-150	1979-2542
	<i>Funiculina quadrangularis</i>	1	0.03%	45	2070
	Pennatulacea	183	5.4%	5-60	1978-2730
	<i>Stachytilum superbum</i>	6	0.2%	10-15	2650
	<i>Umbellula lindahli</i>	4	0.1%	15-20	2048-2648
	<i>Virgularia</i> spp.	9	0.3%	10-15	1995-2597
Soft Coral	<i>Bathyalcyon robustum</i>	2	0.1%	10	2592-2604
	<i>Clavularia</i> spp.	2	0.1%	10-15	2045-2120
	<i>Heteropolypus ritteri</i>	1333	39.6%	5-15	2034-2664
Other	<i>Radicipes stonei</i>	140	4.2%	15-150	2002-2719
<b>TOTAL CORALS</b>		<b>3367</b>			
<b>SPONGES</b>					
Demospongiae	<i>Asbestopluma</i> spp. ("pipecleaner")	135	5.2%	10-40	2038-2611
	<i>Cladorhiza</i> sp.	1325	51.1%	5-15	2001-2706
	<i>Poecillastra</i> spp.	1	0.04%	15	2041
Hexactinellida	<i>Caulophacus (Caulophacus) schulzei</i>	61	2.4%	10-80	2097-2695
	<i>Caulophacus cf. adakensis</i>	1	0.04%	100	2118
	<i>Caulophacus</i> spp.	18	0.7%	10-50	2028-2488
	<i>Farrea occa</i>	63	2.4%	5-40	2014-2662
	<i>Farrea</i> sp. nov.	60	2.3%	10-40	2077-2663
	<i>Heterochone calyx</i>	28	1.1%	5-80	2027-2409
	<i>Rhabdocalyptus dawsoni</i>	809	31.2%	10-60	2038-2666
	<i>Staurocalyptus</i> spp. (white)	13	0.5%	20-90	2077-2125
Morphological	Barrel	31	1.2%	10-45	2077-2220
	Shelf	5	0.2%	20-40	2036-2115
	Upright Flat	4	0.2%	20-40	2034-2102
	Vase	39	1.5%	10-50	2040-2694
	Unidentified	1	0.04%	70	2221
<b>TOTAL SPONGES</b>		<b>2594</b>			

## H1627 Fish Observations from Video

Group	Family	Scientific Name	Common Name	Total	Percent of Total	Depth (m) Range
Eelpout	Zoarcidae	<i>Bothrocara brunneum</i>	Twoline eelpout	2	1%	2648-2733
		<i>Lycodapus</i> spp.	Eelpout	13	8%	2035-2658
		Unknown Zoarcidae	Unidentified eelpout	57	34%	1978-2732
Grenadier	Macrouridae	Unknown Macrouridae	Unidentified grenadier	56	33%	1961-2736
Morids	Moridae	<i>Antimora microlepis</i>	Finescale mora/Pacific flatnose	25	15%	1978-2737
Skate	Arhynchobatidae	<i>Bathyraja aleutica</i>	Aleutian skate	1	1%	2495
		<i>Bathyraja spinosissima</i>	White skate	2	1%	2122-2625
		<i>Raja</i> spp.	Unidentified skate	3	2%	2609-2657
Snailfish	Liparididae	<i>Careproctus kamikawai</i>	Arbiter snailfish	2	1%	2084-2129
		<i>Careproctus ovigerus</i>	Abyssal snailfish	3	2%	2663-2674
	Liparididae	Unidentified snailfish	6	4%	2129-2737	
<b>TOTAL FISH</b>				<b>170</b>		

Other observation: 16 *Graneledone boreopacifica* octopus, three observations of marine debris including a glass bottle, metal pipe or bucket filled with mud, plastic (bag) wrapped around a rock near a *Bathypathes patula* black coral. There was also a long straight mark in the mud that could have been created by anthropogenic force.

## Description of H1627

H1627, Box Canyon, is the deepest of all the dives on NA085 and had a maximum bottom depth of 2,737 meters and a minimum bottom depth of 1,976 meters. At the start of this dive around 2,700 meters the corals are similar to those seen on the first deep Bodega Canyon dive (H1625) with abundant *Lepidisis* spp., the thin branched morphology *Keratoisis* sp. 1, and small *Umbellapathes* spp. black corals. Corkscrew corals, *Radicipes stonei*, were commonly seen and collected three times on this dive. There was only one other *Radicipes stonei* seen on Bodega Canyon dive 1 (H1625), which provides valuable information about this species preference for deeper depths (2002-2719 m) as it is a range extension; only previously found at two localities in the Aleutian Islands, Alaska (Ralf Cordeiro and Gary Williams, pers. comm.).

Three observations of the black coral *Alternatipathes alternata* were seen on this dive. They were originally identified as *Bathypathes* spp. while onboard, but they are a lighter color and the morphology is more delicate and tapered at the tip like a feather than the more commonly seen brown *Bathypathes patula* that was collected. If *Alternatipathes alternata* is seen again on future dives one should be collected. Another species variation that came into question are the types of thinly branched bamboo coral that branch at the node and internode. One bamboo specimen collection (NA085-046) was collected as a snip of a long branch (no branches collected) and was identified as *Keratoisis* sp. 1, however in the video it is clear when the ROV zooms in on the coral that the branches are from the nodes (which is not a characteristic of *Keratoisis*). The smaller and less descriptive bamboo corals at these deep depths need to be better sampled on future dives to understand if they are *Isidella* spp. or possibly branched *Lepidisis* spp. Many taxonomic keys for Isididae corals use “colonies unbranched” to distinguish *Lepidisis* spp. from other bamboo species. However, a study that analyzed mitochondrial DNA sequence variation from Isidids, found that branching morphology was not a good indicator of genus<sup>4</sup>.

<sup>4</sup>France, S.C. 2007. Genetic Analysis of Bamboo Corals (Cnidaria: Octocorallia: Isididae): Does Lack of Colony Branching Distinguish *Lepidisis* from *Keratoisis*? Bulletin of Marine Science, 81 (3): 323-333.

There are also smaller and “bushier” bamboo corals that could be *Acanella* spp. and a collection of an individual on future dives would be valuable. Bamboo coral taxonomy is currently under revision, so more collections will help understand taxonomy based on morphology for these varieties of very deep water bamboo corals that we have very little information about in CBNMS.

Overall, the abundance of corals (specifically bamboo corals) were low at 2,700 m despite there being steep vertical walls with evidence of strong water currents. In these habitats the most abundant species were the stalked sponge *Cladorhiza* sp. and Corallimorph anemones.

At 2,111 meters there was a tall overhanging cliff face that was covered in a variety of sponges and corals (at least six coral taxa, at least ten sponge taxa). The ROV spent considerable time documenting this feature. Nearby there were vertical walls covered in barrel sponges (*Rhabdocalyptus dawsoni*) and mushroom corals (*Heteropolypus ritterii*). Most of the *Rhabdocalyptus dawsoni* sponges were oriented with their osculum facing down, possibly to better capture food in the strong currents being pushed up the walls the sponges are covering.

Overall, the lowest total count of fish and the fewest fish taxa were observed on H1627 compared to the other dives conducted on NA085. Of the 170 total fish, the greatest percent of total were unidentified eelpouts (Zoarcidae) and Grenadiers (Macrouridae).

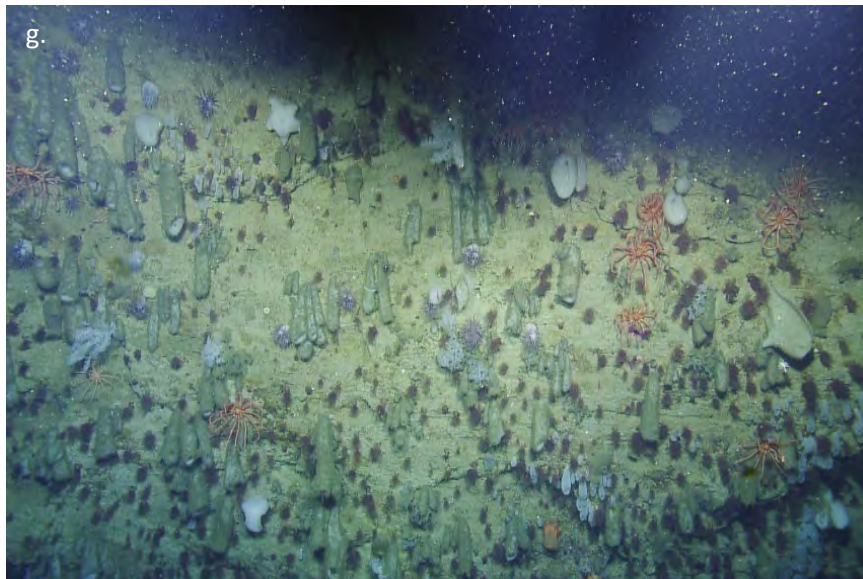
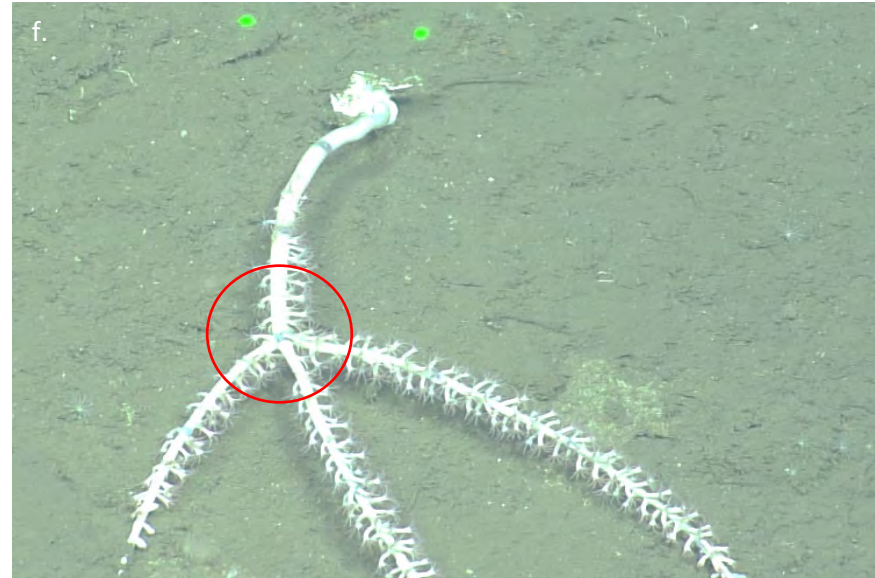
## Representative pictures of H1627



(a.) Black coral, *Alternatipathes alternata* (b.) Sponge, *Caulophacus schulzei*, was collected and determined to be a range extension from Point Conception, California (c.) Corkscrew coral, *Radicipes stonei*, was collected and determined to be a range extension from Aleutian Islands, Alaska (d.) Flat morphology of *Farrea* sp. nov. was collected and is to be described.



Representative pictures from H1627



(e.) Bamboo specimen collection (NA085-046) with branches at nodes (black bands), more of these types should be collected (f.) Undetermined bamboo coral species with visible branching at the node; these are the types to be collected on future surveys (g.) Vertical walls covered in barrel sponges (*Rhabdocalyptus dawsoni*) and mushroom corals (*Heteropolypus ritteri*). Most of the *Rhabdocalyptus dawsoni* sponges were oriented with their osculum facing down (h.) Tall overhanging cliff face that was covered in a variety of sponges and corals (at least six coral taxa, at least ten sponge taxa).

## SUMMARY OF DIVES H1628 and H1629 – Southwest of Cordell Bank

### H1628 Dive Details

ROV details:		CTD (on bottom) details:	
Date Time ROV in water (UTC)	8/10/17 8:01 AM	Average Temperature (c)	3.8
Date Time ROV on deck (UTC)	8/10/17 12:18 PM	Minimum Temperature (c)	3.5
Date Time ROV on bottom (UTC)	8/10/17 8:53 AM	Maximum Temperature (c)	4.4
Date Time ROV off bottom (UTC)	8/10/17 11:16 AM	Average O2 Concentration (ml/L)	0.3
ROV Maximum Depth (m)	1126	Minimum O2 Concentration (ml/L)	0.2
ROV Off Bottom Depth (m)	1005	Maximum O2 Concentration (ml/L)	0.4
ROV Average Depth (m)	1062	Average O2 Saturation (%)	2.9
Total Dive Time (hrs)	4.29	Minimum O2 Saturation (%)	1.9
Total Bottom Time (hrs)	2.38	Maximum O2 Saturation (%)	3.9

### H1629 Dive Details

ROV details:		CTD (on bottom) details:	
Date Time ROV in water (UTC)	8/10/17 3:53 PM	Average Temperature (c)	4.1
Date Time ROV on deck (UTC)	8/11/17 2:08 AM	Minimum Temperature (c)	3.9
Date Time ROV on bottom (UTC)	8/10/17 4:35 PM	Maximum Temperature (c)	4.8
Date Time ROV off bottom (UTC)	8/11/17 12:54 AM	Average O2 Concentration (ml/L)	0.2
ROV Maximum Depth (m)	988	Minimum O2 Concentration (ml/L)	0.2
ROV Off Bottom Depth (m)	866	Maximum O2 Concentration (ml/L)	0.2
ROV Average Depth (m)	945	Average O2 Saturation (%)	2.1
Total Dive Time (hrs)	10.25	Minimum O2 Saturation (%)	1.9
Total Bottom Time (hrs)	8.31	Maximum O2 Saturation (%)	2.6

### H1628 and H1629 Collections (corals and sponges)

# Sample ID	CAS IZ#	Genus/FAMILY/HIGHER TAXON	Species	Date Time (UTC)	Latitude	Longitude	Depth (m)	Temp (c)	Salinity	O2 Conc.
NA085-059	220973	<i>Virgularia</i>		8/10/2017 10:35	37.9813	-123.4942	1033	3.9	34.4	11.0
NA085-060	220962	<i>Halipteris</i>	<i>californica</i>	8/10/2017 11:03	37.9813	-123.4929	1015	4.1	34.4	8.4
NA085-061	223279	<i>Stauracalyptus</i>		8/10/2017 17:25	37.9836	-123.4932	981	4.1	34.4	8.7
NA085-063	220957	<i>Gersemia</i>	<i>julepackardae</i>	8/10/2017 17:46	37.9835	-123.4932	981	4.0	34.4	8.9
NA085-065	220967	<i>Paragorgia</i>	<i>yutlinux</i>	8/10/2017 18:51	37.9840	-123.4923	947	4.1	34.4	8.5
NA085-067	220958	<i>Psammogorgia (Swiftia)</i>	<i>torreyi</i>	8/10/2017 19:29	37.9837	-123.4926	949	4.0	34.4	9.7
NA085-068	220970	<i>Paragorgia</i>	<i>yutlinux</i>	8/10/2017 19:48	37.9834	-123.4928	946	4.1	34.4	8.3
NA085-069	220974	<i>Stachyptilum</i>	<i>superbum</i>	8/10/2017 20:07	37.9834	-123.4928	946	4.2	34.4	8.1
NA085-070	220975	<i>Umbellula</i>		8/10/2017 21:10	37.9857	-123.4964	963	4.1	34.4	8.5
NA085-071	220976	<i>Funiculina</i>	<i>quadrangularis</i>	8/10/2017 21:15	37.9857	-123.4964	963	4.1	34.4	8.5

### Other taxa and other collections

- Two Niskin water samples and three sediment push cores were collected on H1628/H1629
- Other taxa identified from samples include: *Aeolidia herculea* (Nudibranch), Caridea, and sample 072 is a nudibranch collected in a slurp but was not identified by CAS.

## H1628 and H1629 Coral and Sponge Observations from Video

Common Name	Scientific Name	Total Number	Percent of Total	Height Range (cm)	Depth (m) Range
<b>CORALS</b>					
Bamboo Coral	<i>Lepidisis</i> spp.	1	0.1%	25	914
Black Coral	<i>Bathypathes patula</i>	2	0.2%	10-30	912-977
Bubblegum	<i>Paragorgia arborea</i>	1	0.1%	20	903
	<i>Paragorgia yutlinux</i>	83	6.9%	10-90	892-952
Gorgonians	<i>Psammogorgia (Swiftia) simplex</i>	16	1.3%	10-35	891
	<i>Psammogorgia (Swiftia) torreyi</i>	102	8.5%	10-25	889-988
Sea Pens	<i>Funiculina quadrangularis</i>	314	26.1%	5-30	959-1124
	<i>Halipteris californica</i>	55	4.6%	5-40	865-1013
	Pennatulacea	4	0.3%	10-15	951-970
	<i>Stachytilum superbum</i>	194	16.2%	5-30	940-1032
	<i>Umbellula lindahli</i>	4	0.3%	10-15	942-963
	<i>Virgularia</i> spp.	40	3.3%	5-10	940-1032
Soft Coral	<i>Clavularia</i> spp.	1	0.1%	50	944
	<i>Gersemia juliepackardae</i>	39	3.2%	5-20	889-980
	<i>Heteropolypus ritteri</i>	345	28.7%	5-15	866-988
<b>TOTAL CORALS</b>		<b>1201</b>			
<b>SPONGES</b>					
Demospongiae	<i>Asbestopluma</i> spp. ("pipecleaner")	30	4.8%	5-15	931-987
	<i>Poecillastra</i> spp.	185	29.9%	5-40	889-988
Hexactinellida	<i>Farrea occa</i>	5	0.8%	10-25	889-949
	<i>Heterochone calyx</i>	121	19.5%	10-80	900-972
	<i>Hexactinella</i> spp.	1	0.2%	15	904
	<i>Rhabdocalypus dawsoni</i>	111	17.9%	10-40	889-987
	<i>Staurocalypus</i> spp. (yellow)	120	19.4%	10-70	900-987
Morphological	Barrel	16	2.6%	10-40	901-980
	Shelf	1	0.2%	25	972
	Vase	29	4.7%	10-25	895-988
<b>TOTAL SPONGES</b>		<b>619</b>			

## H1628 and H1629 Fish Observations from Video

Group	Family	Scientific Name	Common Name	Total	Percent of Total	Depth (m) Range
Catshark	Pentanchidae	<i>Apristurus brunneus</i>	Brown catshark	1	0.1%	961
Eelpout	Zoarcidae	<i>Bothrocara brunneum</i>	Twoline eelpout	4	0.3%	985-1065
		<i>Lycenchelys crotalinus</i>	Snakehead eelpout	74	5%	867-1116
		<i>Lycenchelys</i> spp.	Eelpout	47	3%	952-1126
		<i>Lycodapus</i> spp.	Eelpout	89	6%	864-1124
		Unknown Zoarcidae	Unidentified eelpout	46	3%	865-1124
Flatfish	Pleuronectidae	<i>Embassichthys bathybius</i>	Deepsea sole	40	3%	884-1118
		<i>Microstomus pacificus</i>	Dover sole	40	3%	865-1126
		Unknown Pleuronectidae	Unidentified flatfishes	20	1%	927-1124
Grenadier	Macrouridae	Unknown Macrouridae	Unidentified Grenadier	34	2%	963-1125
Rockfish	Scorpaenidae	<i>Sebastolobus alascanus</i>	Shortspine thornyhead	18	1%	888-1124
		<i>Sebastolobus altivelas</i>	Longspine thornyhead	34	2%	879-1124
		<i>Sebastolobus</i> spp.	Unidentified thornyheads	978	66%	865-1124
Skate	Rajidae	<i>Bathyraja trachura</i>	Roughtail skate	4	0.3%	891-1076
		<i>Raja</i> spp.	Unidentified skate	1	0.1%	985
Snailfish	Liparididae	<i>Careproctus kamikawai</i>	Arbiter snailfish	4	0.3%	869-950
		<i>Careproctus melanurus</i>	Blacktail snailfish	1	0.1%	866
		Liparididae	Unidentified snailfish	2	0.1%	891-940
Other	Alepocephalidae	<i>Alepocephalus tenebrosus</i>	California slickhead	4	0.3%	890-1094
	Anoplopomatidae	<i>Anoplopoma fimbria</i>	Sablefish	9	1%	881-1108
	Myxinidae	<i>Eptatretus</i> sp.	Hagfish	38	3%	882-1118
<b>TOTAL FISH</b>				<b>1488</b>		

Other observations: one *Graneledone boreopacifica* octopus. Direct evidence of historic bottom trawling in the area when the ROV found a large pile of thick rope laying on the bottom in loops and four minutes later a large trawl net extended in the water column hung between rocks. Four hours later into the dive at the base of a rock wall was a European style round trawl door (uncommon gear type used on the U.S. west coast) with no ropes or nets attached to it. The trawl door was rusted and covered in sediment.

### Description of H1628/H1629

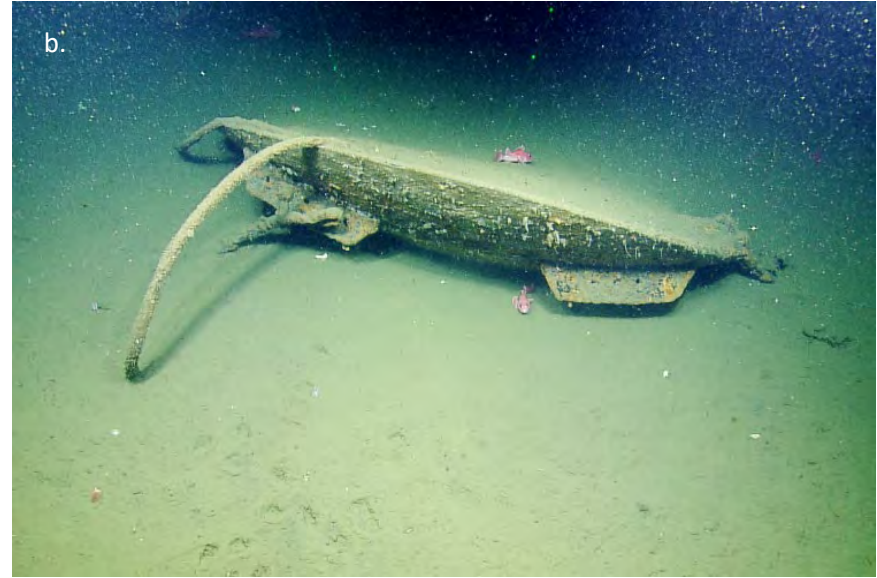
H1628/H1629, southwest of Cordell Bank, had a maximum bottom depth of 1,126 meters on H1628 and a minimum bottom depth of 866 meters on H1629. This dive started as H1628 for about 2 hours on the bottom until there was a break in a hose on the manipulator arm that required the ROV to be immediately brought to the surface for repairs. Once the issue was fixed, the dive continued as H1629 at the same site and therefore the animal observation data has been joined for these two dives in the area on the deep slope southwest of Cordell Bank.

This was the shallowest of all the dives completed thus far on NA085. Overall the diversity of corals and sponges was lower than seen on previous dives. There were large expanses of all mud bottom where the sea pen species dominated. The limited observations of bamboo, black, and primnoid coral species are very telling of the deeper depths and rocky habitats these taxa prefer. The first observations of peppermint coral, *Paragorgia yutlinux*, were seen on this dive and account for nearly 7% of all coral counts. There was only one bubblegum coral, *Paragorgia arborea*, counted. Gorgonians were commonly seen and the fan shaped morphology, *Psammogorgia (Swiftia) torreyi*, was more abundant than the branched morphology *Psammogorgia (Swiftia) simplex*. In the soft coral category, *Gersemia*

*juliepackardae*, was observed in higher abundances than seen on previous dives. There was a rock wall with dense and diverse sponge cover including very large goiter sponges (*Heterochone calyx*), yellow Picasso sponges (*Staurocalyptus spp.*), and fringed shelf sponges (*Poecillastra spp.*). As was observed on a previous dive (H1626) many (38% of total) of the *Heterochone calyx* were documented in a condition that was dying or dead.

Fish were abundant on this area of the slope, the shallower depths supported Thornyhead rockfish that accounted for 69% of total fish observed.

## Representative pictures of H1628/H1629



(a.) Rock wall with dense and diverse sponge cover including large goiter sponges (*Heterochone calyx*), yellow Picasso sponges (*Staurocalyptus* spp.), and fringed shelf sponges (*Poecillastra* spp.) (b.) European style round trawl door found at base of rock wall (c.) Peppermint coral, *Paragorgia yutlinux*, was collected (d.) Variety of sea pen species documented on this dive include: *Funiculina quadrangularis*, *Halipteris californica*, *Virgularia* spp., and *Stachytilum superbum*

## SUMMARY OF DIVE H1630 – Bodega Canyon III

### H1630 Dive Details

ROV details:		CTD (on bottom) details:	
Date Time ROV in water (UTC)	8/11/17 11:23 AM	Average Temperature (c)	3.8
Date Time ROV on deck (UTC)	8/12/17 1:25 AM	Minimum Temperature (c)	3.1
Date Time ROV on bottom (UTC)	8/11/17 12:24 PM	Maximum Temperature (c)	5.5
Date Time ROV off bottom (UTC)	8/12/17 12:03 AM	Average O2 Concentration (ml/L)	0.3
ROV Maximum Depth (m)	1291	Minimum O2 Concentration (ml/L)	0.1
ROV Off Bottom Depth (m)	744	Maximum O2 Concentration (ml/L)	0.5
ROV Average Depth (m)	1072	Average O2 Saturation (%)	3.4
Total Dive Time (hrs)	14.03	Minimum O2 Saturation (%)	1.6
Total Bottom Time (hrs)	11.65	Maximum O2 Saturation (%)	5.8

### H1630 Collections (corals and sponges)

# Sample ID	CAS IZ#	Genus/FAMILY/HIGHER TAXON	Species	Date Time (UTC)	Latitude	Longitude	Depth (m)	Temp (c)	Salinity	O2 Conc.
NA085-076	N/A	dead bamboo coral		8/11/2017 14:04	38.2292	-123.6045	1259	3.2	34.5	21.1
NA085-078	223596	<i>Bathypathes</i>		8/11/2017 14:11	38.2292	-123.6045	1258	3.2	34.5	21.4
NA085-079	N/A	dead bamboo coral ( <i>Isidella</i> )		8/11/2017 14:24	38.2293	-123.6042	1254	3.2	34.5	21.6
NA085-080	N/A	dead bamboo coral ( <i>Keratoisis</i> )		8/11/2017 14:29	38.2293	-123.6043	1255	3.2	34.5	21.7
NA085-081	220951	<i>Keratoisis</i>	sp. 2	8/11/2017 14:58	38.2294	-123.6046	1246	3.2	34.5	21.7
NA085-083	223580	<i>Lillipathes</i>		8/11/2017 15:31	38.2293	-123.6041	1244	3.2	34.5	21.5
NA085-084	220950	<i>Isidella</i>	<i>tentaculum</i>	8/11/2017 16:02	38.2296	-123.6035	1229	3.2	34.5	20.9
NA085-085	220956	<i>Psammogorgia</i> ( <i>Swiftia</i> )	<i>simplex</i>	8/11/2017 18:50	38.2290	-123.5861	987	3.9	34.4	9.7

### Other taxa and other collections

- Six Niskin water samples and one sediment push cores were collected on H1630
- Other associated taxa identified from samples include: *Harmothoe cf. fragilis*

## H1630 Coral and Sponge Observations from Video

Common Name	Scientific Name	Total Number	Percent of Total	Height Range (cm)	Depth (m) Range
<b>CORALS</b>					
Bamboo Coral	Isididae	42	2.6%	10-140	960-1259
	<i>Isidella</i> spp.	2	0.1%	40	1105
	<i>Isidella tentaculum</i>	23	1.4%	25-220	929-1254
	<i>Keratoisis</i> sp. 2 (thick branches)	124	7.8%	15-220	910-1259
	<i>Lepidisis</i> spp.	3	0.2%	30-40	1211-1219
Black Coral	Antipatharia	15	0.9%	10-60	1203-1277
	<i>Bathypathes patula</i>	1	0.1%	25	1258
	<i>Lillipathes</i> spp.	9	0.6%	15-50	1238-1262
	<i>Parantipathes</i> spp.	2	0.1%	15	1260-1261
	<i>Trissopathes</i> spp.	15	0.9%	20-70	1213-1284
	<i>Umbellapathes</i> sp.	1	0.1%	15	1082
Bubblegum	<i>Paragorgia arborea</i>	103	6.5%	5-55	911-1258
	<i>Paragorgia yutlinux</i>	248	15.5%	5-70	897-1105
Gorgonians	<i>Acanthogorgia</i> spp.	1	0.1%	15	1212
	Alcyonacea	16	1.0%	10-40	975-1285
	<i>Psammogorgia (Swiftia) simplex</i>	158	9.9%	10-70	897-1276
	<i>Psammogorgia (Swiftia) torreyi</i>	389	24.4%	10-35	905-1285
Primnoids	<i>Parastenella ramosa</i>	47	2.9%	10-45	921-1121
	Primnoidae	1	0.1%	20	1277
Sea Pens	<i>Halipteris californica</i>	43	2.7%	15-50	989-1291
	Pennatulacea	42	2.6%	10-45	1031-1248
Soft Coral	<i>Clavularia</i> spp.	1	0.1%	20	944
	<i>Gersemia juliepackardae</i>	6	0.4%	10-15	914-989
	<i>Heteropolypus ritteri</i>	303	19.0%	5-20	900-1277
<b>TOTAL CORALS</b>		<b>1595</b>			
<b>SPONGES</b>					
Demospongiae	<i>Asbestopluma</i> spp. ("pipecleaner")	3	0.5%	10-15	983-1244
	<i>Poecillastra</i> spp.	246	38.0%	10-50	918-1285
Hexactinellida	<i>Farrea occa</i>	11	1.7%	10-60	925-1204
	<i>Heterochone calyx</i>	50	7.7%	10-80	936-1284
	<i>Hexactinella</i> spp.	14	2.2%	5-15	915-990
	<i>Rhabdocalyptus dawsoni</i>	9	1.4%	15-45	916-1191
	<i>Staurocalyptus</i> spp. (yellow)	302	46.7%	10-100	912-1003
	<i>Staurocalyptus</i> spp. (white)	5	0.8%	25-60	938-1011
Morphological	Barrel	5	0.8%	15-30	989-1244
	Vase	2	0.3%	20-30	952-954
<b>TOTAL SPONGES</b>		<b>647</b>			



## H1630 Fish Observations from Video

Group	Family	Scientific Name	Common Name	Total	Percent of Total	Depth (m) Range
Catshark	Pentanchidae	<i>Apristurus brunneus</i>	Brown catshark	1	0.1%	998
Eelpout	Zoarcidae	<i>Bothrocara brunneum</i>	Twoline eelpout	8	0.5%	1047-1287
		<i>Lycenchelys crotalinus</i>	Snakehead eelpout	50	3%	1008-1186
		<i>Lycenchelys</i> spp.	Eelpout	95	6%	1019-1291
		<i>Lycodapus</i> spp.	Eelpout	56	3%	988-1289
		Unknown Zoarcidae	Unidentified eelpout	31	2%	1023-1290
Flatfish	Pleuronectidae	<i>Embassichthys bathybius</i>	Deepsea sole	90	5%	897-1291
		<i>Microstomus pacificus</i>	Dover sole	44	3%	917-1288
		Unknown Pleuronectidae	Unidentified flatfishes	4	0.2%	931-1174
Grenadier	Macrouridae	Unknown Macrouridae	Unidentified grenadier	184	11%	994-1291
Morids	Moridae	<i>Antimora microlepis</i>	Finescale mora/Pacific flatnose	24	1%	1062-1290
		<i>Physiculus rastrelliger</i>	100 fathom codling	1	0.1%	1082
Rockfish	Scorpaenidae	<i>Sebastolobus alascanus</i>	Shortspine thornyhead	16	0.9%	903-1291
		<i>Sebastolobus altivelas</i>	Longspine thornyhead	21	1%	923-1289
		<i>Sebastolobus</i> spp.	Unidentified thornyheads	1012	59%	897-1291
Skate	Rajidae	<i>Bathyraja trachura</i>	Roughtail skate	16	0.9%	897-1258
Snailfish	Liparididae	<i>Careproctus kamikawai</i>	Arbiter snailfish	7	0.4%	939-1289
		<i>Careproctus melanurus</i>	Blacktail snailfish	2	0.1%	1195-1247
	Liparididae	Unidentified snailfish	9	0.5%	1046-1288	
Other	Agonidae	Agonidae	Unidentified poacher	10	0.6%	1017-1083
	Alepocephalidae	<i>Alepocephalus tenebrosus</i>	California slickhead	12	0.7%	1003-1195
	Anoplopomatidae	<i>Anoplopoma fimbria</i>	Sablefish	12	0.7%	977-1263
	Cottidae	<i>Psychrolutes phrictus</i>	Blob sculpin	1	0.1%	1283
	Myxinidae	<i>Eptatretus</i> sp.	Hagfish	17	1%	916-1147
<b>TOTAL FISH</b>				<b>1723</b>		

Other observations: 10 *Graneledone boreopacifica* octopus, 11 observations of marine debris including 8 observations of plastic bags/sheets and 3 observations of line/rope.

## Description of H1630

H1630, Bodega Canyon III, was the shallowest dive conducted in Bodega Canyon with a maximum bottom depth of 1,291 meters and a minimum bottom depth of 744 meters. At the start of the dive there were many large thickly branched *Keratoisis* sp. 2 and some large *Isidella tentaculum* bamboo corals. Some of the very large *Keratoisis* sp. 2 reached 220 cm in height and 300 cm in width. They were growing from the vertical walls, extending horizontally into the water column with large bases supporting extensive branches. It is likely this growing strategy is for the coral's polyps to capitalize on food delivery from the upward flowing water current. At the base of the wall there was an area of cobbles and boulders with a scattering of dead bamboo skeletons with broken branches, but the coral bases were still attached to the loose pieces of rock. It is probable that these dead corals fell from the upper walls observed earlier in the dive possibly caused by a natural force as these habitats did not appear to be suitable for the use of bottom contact fishing gear that is known to disrupt benthic organisms. Bubble gum corals, *Paragorgia arborea*, were also very abundant at the same depth range as the *Keratoisis* sp. 2 (910 to 1,300 meters).

As the dive depths decreased there was a clear transition from bamboo corals to primnoid, *Parastenella ramosa*, and gorgonians *Psammogorgia (Swiftia) torreyi* and *Psammogorgia (Swiftia)*

*simplex*. Around 900 meters peppermint corals (*Paragorgia yutlinux*) become very abundant, many of the larger individuals are shaped like candelabras, similar to the morphology of *Isidella tentaculum*. During the last three hours of the dive the habitat type of the canyon was primarily rock walls made up of sedimentary layers. There was a mud veneer on the rocks and fewer coral and sponges than seen earlier in the dive, although there was one area at 970 meters with very abundant yellow Picasso sponges (*Staurocalyptus* spp.) and *Paragorgia yutlinux* peppermint corals.

Fish taxa diversity and abundance was greatest on H1630 compared to all previous NA085 dives due to the shallower depth ranges surveyed on this dive. The greatest percent of total fish counts were Thornyhead rockfish, *Sebastolobus* spp. (61%).

## Representative pictures of H1630



(a.) Large *Keratoisis* sp. 2 bamboo coral extending from the canyon walls (b.) Dead bamboo corals with bases still attached to rocks, one of these was collected for aging (c.) Large *Isidella tentaculum* bamboo coral (d.) Candelabra shaped peppermint coral, *Paragorgia yutlinux*, and below is the branched morphology gorgonian *Psammogorgia (Swiftia) simplex*

## Discussion

This deep water exploration greatly expanded our knowledge of deep sea corals, sponges, fishes, other invertebrates, and habitats of the deepest canyon and slope regions of Cordell Bank National Marine Sanctuary. It is remarkable that at least 31 new coral observations were documented for the sanctuary and 39 total coral collections from 23 taxa were made to confirm species identification from video imagery.

In addition to the new data of deep-sea coral and sponge diversity in CBNMS we also have a better understanding of how coral species presence varies by depth range. The large range of depths (744-2,737 meters) surveyed on all dives revealed transitions in corals species from deeper to shallower depths. The species and depth descriptions below do not incorporate frequency of individuals and it is understood that these general trends would be more telling if density estimates were available and incorporated.

### *Bamboo coral occurrence from deep to shallow appears to be:*

Isididae sp. 2 (possible branched *Lepidisis* spp.) and thin branched *Keratoisis* sp. 1 → *Acanella* spp. → thick branched *Keratoisis* spp. 2 and *Isidella tentaculum*. Single stalked *Lepidisis* spp. were found across all deep to shallow depths but were generally taller at deeper depths.

### *Black coral occurrence from deep to shallow appears to be:*

*Bathypathes patula*, *Parantipathes* spp., *Trissopathes* spp., and *Umbellapathes* spp. all generally occurred at the full depth distribution surveyed on all dives. The exceptions was *Alternatipathes alternata* found at the maximum depth extent of dive H1627 and in limited numbers. *Lillipathes* spp. were seen at the shallower extent of depths surveyed.

### *Paragorgid coral occurrence from deep to shallow appears to be:*

*Paragorgia yutlinux* (peppermint coral) inhabits shallower depths (892-1,105 m) than the large depth extent of *Paragorgia arborea* (bubblegum coral) (903-2,451 m).

### *Gorgonian coral occurrence from deep to shallow appears to be:*

*Acanthogorgia* spp. (gold coral) → *Psammogorgia (Swiftia) torreyi* (fan shaped) → *Psammogorgia (Swiftia) simplex* (branched). *Psammogorgia (Swiftia) torreyi* has a large depth distribution being found 880 meters deeper than *Psammogorgia (Swiftia) simplex*.

### *Primnoid coral occurrence from deep to shallow appears to be:*

*Narella* spp. → *Callogorgia kinoshitae* → *Parastenella ramose*

### *Sea pen occurrence from deep to shallow appears to be:*

Species were generally found to inhabit the full range of depths surveyed on mud bottoms with the exception of *Distichoptilum gracile* occurring at the deeper depth range.

### *Soft coral occurrence from deep to shallow appears to be:*

*Heteropolypus ritteri* was seen on all dives across all depth ranges and often in high numbers. Other soft corals like *Gersemia juliepackardae* prefers shallower depths than *Clavularia* spp.

## Next Steps

There were at least five areas seen on this cruise that were spectacular coral and sponge “gardens.” Additional analyses were conducted to determine if the orientation and aspect of these rock wall areas are different than the surrounding dive areas. These walls are in line with prevailing currents and nutrient flow, influencing the high abundance and diversity of corals and sponges. Another physical oceanographic factor that could be influencing coral distribution is water carbonate chemistry; this is being studied by UC Davis scientists.

The results from extracting aspect direction from the raster dataset in ArcGIS for each coral and sponge observation showed us that on NA085 we primarily sampled steep sloped areas with a south to southwest aspect. Dive target areas in CBNMS for *Nautilus* cruise NA116 in October 2019 are in areas with north to northwest aspect. This will allow us to better characterize canyon features with this orientation into the prevailing ocean current system as this could greatly influence coral and sponge occurrence.

Sample collections on the 2019 *Nautilus* cruise (NA116) will focus on the smaller and less distinctive bamboo corals observed at deeper depths. Many of the questionable *Isididae* spp. appeared in the 2017 video imagery to be branched at the node or internode and it is hard to determine *Isidella* spp. or branched *Lepidisis* spp. in video from other thinly branched *Keratoisis* spp. 1 when nodes are not visible (*Keratoisis* does not branch at the node). Often the collected samples of bamboo corals did not include branches with multiple nodes and on a few occasions this caused a mismatch in species identification in the lab versus seeing the full specimen in situ. Whole corals or larger snips with multiple branches will be collected on NA116 to support further taxonomic studies of this group of corals.

Collections of black corals will also be a priority on the 2019 *Nautilus* mission in CBNMS. When the ROV was flying high from the seafloor it was difficult to determine the differences between *Lillipathes* spp., *Parantipathes* spp., and *Trissopathes* spp. black corals. All of these corals have an overall fan shaped morphology but the details in the pattern of the branches help for identification from video imagery. Another black coral, *Alternatipathes alternata*, could be confused for *Bathypathes patula* from a distance. However, *A. alternata* are a lighter color with a morphology that is more delicate and tapered at the tip like a feather than *B. patula*. If *A. alternata* is seen again on the 2019 dives one should be collected.

Sponges were under sampled in 2017 and should be more of sampling priority in 2019 including the large mushroom shaped stalked sponge that could be a range extension from Alaska (*Caulophacus* cf. *adakensis*).

A species collection list that was developed by CBNMS, GFNMS, CAS, and NMFS will be kept by the watch leads on NA116 to keep track of collections. This will be a method to communicate with each other since personnel changes during watch shifts every four hours. A photo identification guide has been made from the images collected on NA085 and will be available to all watch teams to assist in species recognition and identification. Collections and identifications made on future cruises may lead to revisions in our earlier identifications.

## Acknowledgments

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## Addendum for Sponge Collection from NA085

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This document provides additional descriptions of the sponges referenced in the above report “First Characterization of Deep Sea Habitats in Cordell Bank National Marine Sanctuary” (Graiff and Lipski, 2019) from an expedition aboard the E/V *Nautilus* from August 6-12, 2017; cruise number NA085.

Since the finalization of the report in 2019, descriptions of the sponge collections from NA085 were published in a Zootaxa article by sponge expert Henry M. Reiswig from the Department of Biology, University of Victoria and Natural History Section, Royal British Columbia Museum, Victoria, BC.

The new findings include:

- 1) *Farrea* sp. nov has been described as the new species *Farrea cordelli*. Collected at 2119.9 m and is known only as a single specimen from Cordell Bank National Marine Sanctuary (CBNMS).
- 2) *Cladorhiza* sp. was identified to species *Cladorhiza bathyrcrinoides*. Only previously known from Sea of Okhotsk, Pacific coast of the Kurile Islands; the CBNMS specimen is an astonishing geographic range extension of at least 6382 km from its previously known occurrence.
- 3) *Staurocalyptus* spp. (yellow) was identified to the species *Staurocalyptus pamelaturnerae*. Known from only two locations: the holotype from Greater Farallones National Marine Sanctuary and the present specimen from CBNMS from depths of 806–981 m.
- 4) *Rhabdocalyptus dawsoni* barrel shaped sponge is well known for this region with a geographic distribution from southern California to Cape Spencer, Alaska and probably into the Bering Sea at depths of 10-437 m but the specimen collected from CBNMS extended the known depth distribution by nearly four times, from 437 to 2113 m.
- 5) *Caulophacus (Caulophacus) schulzei* is known to have a very wide distribution from the Tasman Sea, N. Peru, Ecuador, Gulf of Panama, Central California and the Bering Sea from 3183-4510 m depths. The specimen collected in CBNMS is a geographic range extension 353 km north of its previous most northern point reported on the coast from Pt Conception, CA and provides the first *in situ* image of the species.

### Reference:

- Reiswig, H. M. 2020. Report of *Cladorhiza bathyrcrinoides* Koltun (Demospongiae) from North America and a new species of *Farrea* (Hexactinellida) among sponges from Cordell Bank, California. *Zootaxa* 4747 (3): 562–574.